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TECHNICAL REPORT ARLCD-TR-78018

TNT EQUIVALENCY OF COMPOSITION A5

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DOVER, NEW JERSEY

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Peak blast overpressure and scaled positive blast impulse have been measured for Composition A5 using configurations that simulate bulk handling of material during processing and shipment. Quantities of 11.34, 22.7, and 27.22 kg (25, 50, and 60 lb, respectively) were tested in orthorhombic fiberboard boxes, and 68.04 kg (150 lb) were detonated in cylindrical fiber containers. High-explosive equivalency values for each test series were obtained as a function of scaled distance by comparison to known pressure, arrival time and impulse characteristics for hemispherical TNT surface bursts. The equivalencies were found to

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depend significantly on scaled distance with higher values (140 to 500%) at the extremes within the range from 1.19 to 15.87 $m/kg^{1/3}$ (3 to 40 $ft/lb^{1/3}$, respectively). Equivalencies as low as 100% were obtained at intermediate distances. Within experimental error, both peak overpressure and positive impulse scaled as a function of charge weight for all quantities tested in the orthorhombic configuration.

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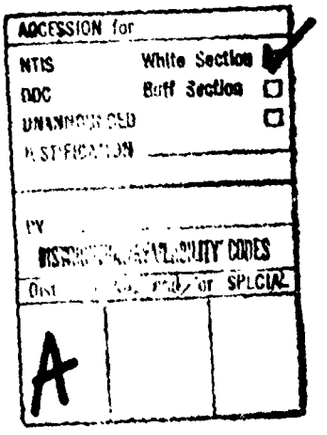

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SUMMARY

Composition A5 high explosive, Type I, MIL-E-14970A(MU) was detonated in configurations representative of an orthorhombic shipping box, a simulated in-plant conveyor bucket, and a cylindrical shipping drum. Blast output parameters were measured and TNT equivalency was computed based on comparison with TNT hemispherical surface bursts. The tests and the results are presented in table 1 and in figures 1, 2, 3 and 4. Within the boundaries of experimental error, the pressures and impulses from the orthorhombic configurations scaled with the cube root of the charge weight. The cylindrical charge configuration shows the same general characteristics as the orthorhombic configuration except that blast pressures and pressure equivalencies are higher in the intermediate scaled distances.

INTRODUCTION

As part of the US Army Munitions Production Base Modernization and Expansion Program, Project 5763142 covers the layout and design of a Load, Assemble, and Pack (LAP) line for grenades to be used in Improved Conventional Munitions (ICM). Although building and equipment designs are not final, it is already known that bulk quantities of the explosive component, Composition A5, ranging from 11.34 (25 lb) to 2700 kg (5950 lb), will be found at various points in the LAP line. Composition A5 will be received in unit quantities of 11.34 kg (25 lb) to 68.0 kg (150 lb) and stored in Stradley igloos. The material will be screened, weighed in 11.34 kg (25 lb) increments, and transferred via bucket conveyor to pressing bays within the grenade-body loading building.

Safety engineering and cost effectiveness require that hazardous material characteristics be considered as input to facility design. In this instance, specific data are required on the explosive output characteristics of Composition A5 in quantities and configurations representative of the processing environment.

The purpose of Project 5763142 is to:

1. Experimentally determine the maximum airblast output; peak overpressure and positive impulse of Composition A5 explosive in specific configurations and in the processing of environment.

2. Determine the TNT equivalencies of the A5 explosive by comparing its measured pressure and positive impulse with those

produced by the detonation of an unconfined ground burst of a hemispherical charge of TNT.

EXPERIMENTAL METHODS

Materials

The test material was Composition A5, Type I, high explosive (MIL-E-14970A (MU), 6 September 1970, with amendment, lot No. HOL-015-73), containing 98.5 to 99.0% RDX and 1.0 to 1.5% stearic acid. The explosive was received from Holston Army Ammunition Plant in standard shipping boxes with a net weight of 27.2 kilograms.

Test Plan

Airblast output was evaluated for weights and configurations of Composition A5 representative of three shipping and in-plant situations. Physical characteristics of the test items were as follows:

1. An orthorhombic container (fig. 5a) was used to simulate the conveyor bucket and serve as a scaled version of the standard shipping box with a linear dimensional scaling factor of 0.80. Two-piece telescoping fiberboard boxes were fabricated and filled with 11.34 kg (25 lb) of Composition A5.

2. A second orthorhombic container (fig. 5b) consisting of the original shipping box was also used to house test material. Tests were performed using 22.68 kg (50 lb), as originally planned, and 27.22 kg (60 lb) charge weights in this configuration. The latter figure approximates the actual shipping weight.

3. In addition to the two orthorhombical containers, a cylindrical fiber shipping drum (fig. 5c) containing 68.04 kg (150 lb) of explosive was tested also.

A conical-shaped booster charge of Composition C4 high explosive was centered in the top of each container and buried with the apex level with the top surface of the test material (fig. 5d). The booster was detonated with an engineer's special J2 blasting cap inserted at the apex and embedded in the center of the cone. A single test of each configuration was performed using a booster equal to 0.05% by weight of the test charge, for which subsequent data analysis showed slightly lower blast pressures than were observed in the case of 1% boosters. Since the TNT equivalent weight of Composition C4 is insignificant during data analysis, assurance of complete detonation

dictated the use of 1% booster weights in all subsequent tests. From three to five tests were performed at each specified charge weight.

The test charge for each configuration was placed on a 1010 carbon steel witness plate 0.61 m (2 ft) by 0.61 m (2 ft) by 0.0064 m (0.2 ft) thick in the center of the test area (fig. 6). The diameter and depth of the crater were measured and the area was refurbished.

Instrumentation

Twelve Susquehanna Instruments Model ST-7 side-on blast transducers were mounted in wooden blocks and placed at ground level in two arrays in the test area shown in figure 7. Distances between transducers and charge were calculated to correspond to scaled distances of 1.19, 1.61, 2.13. 3.57, 7.14, and 15.87 meter/kg$^{1/3}$ (3, 4.04, 5.38, 9, 18 and 40 ft/lb$^{1/3}$, respectively). The transducers were individually calibrated prior to each test series with quasi-static pressure pulses using a standard solenoid-actuated air pressure calibration fixture, adjusted to correspond to expected blast pressures based on an assumed TNT equivalency of 100%. This calibration was verified initially by measuring free-field blast pressures from 0.45 kg (1 lb) bare spherical charges of 50/50 pentolite. Signal line continuity and channelization were checked prior to each test. Details of distances between charge and transducers, calibration pressures, and expected peak blast pressure at each distance are shown in table 2.

Each transducer was connected to an underground coaxial cable system which leads through a dirt bunker and into the instrumentation building, approximately 183 m (600 ft) from the test area. All signals were amplified by Dynamic 6457 units and recorded on a 14-track Sangamo Model 4700 tape recorder at 60 inches per second, along with an initial timing signal from a breakwire placed on the charge and 1.00 kHz timing pulses. The nominal response (-3dB) for this recording system is 80 kHz. Data from Channels 1, 2, 7 and 8 (i.e., the closest transducers) were simultaneously recorded in parallel on a Honeywell Model 96 recorder (500 kHz response) operated at 120 inches per second. Data from the magnetic tapes, read at 19.05 cm (.625 ft) per second, was outputted to a Honeywell Model 1612 oscillograph operated at 101.6 cm (3.33 ft) per second.

Photographic coverage was restricted to the last test of each configuration, (fig. 7). Motion picture coverage included two Hycam Model 41.004 units operated at 4000 frames per second (fps) and one Mitchell camera at 24 fps. Fiducial markers in the field of view with 3.05 meter (10 ft) spacing aided in determination of fireball diameter. Standard meteorological data recorded for each test.

RESULTS

Data Analysis

Peak blast overpressure, time of arrival, and scaled positive impulse information were obtained in direct analog form from the oscillograph records. After exclusion of poor results that could be attributed to instrumentation malfunction, impingement of fragments on the transducer elements, or improper calibration, maximum values for peak pressure and scaled positive impulse were calculated for each weight and scaled distance.

The maximum peak pressures were compared directly with standard reference curves for hemispherical TNT surface bursts (ref. 1) to derive TNT equivalency (E_p) as a percentage by weight based on equivalent side-on blast pressure at equal distance from the charge:

$$E_p = 100\left[\frac{W_{TNT}}{W_{A5}}\right]_{\substack{\text{constant}\\ \text{pressure and}\\ \text{distance}}} = 100\left[\frac{Z^3_{A5}}{Z^3_{TNT}}\right]_{\substack{\text{constant}\\ \text{pressure}}} \tag{1}$$

where W is the weight of explosive, Z is scaled distance, P is the peak blast pressure, and the subscripts refer to the explosive material.

Calculation of TNT impulse equivalency from maximum scaled positive impulse data (I_{A5}) required use of a method similar to that of Swatosh and Cook (ref. 2). The scaled impulse I_{TNT} from TNT hemispheres (I) is given (in metric units) to within experimental uncertainty, by the equation

$$\log I_{TNT} = -0.900 \log Z_{TNT} + 5.52 \tag{2}$$

or $$I_{TNT} = 250/Z_{TNT}^{0.900}. \tag{3}$$

For equal impulses and distances, it is required that

$$\log I_{TNT} - \log I_{A5} = \log Z_{TNT} - \log Z_{A5} \tag{4}$$

The equivalent scaled distance for TNT charges is obtained from A5 impulse data by combining equations (2) and (4):

$$Z_{TNT} = \left(\frac{250\ Z_{A5}}{I_{A5}}\right)^{0.526} \qquad (5)$$

The TNT impulse equivalency (E_I) is then obtained from a relation similar to equation (1):

$$E_I = 100 \left[\frac{Z_{A5}^3}{Z_{TNT}^3}\right]_{\substack{\text{constant} \\ \text{impulse}}} \qquad (6)$$

$$= 0.0163\ Z_{A5}^{1.42}\ I_{A5}^{1.58}$$

Use of this equation eliminates the need for construction plots on log-log graphs.

This method linearizes TNT impulse data below the point of slope reversal by extrapolation of values from greater scaled distances. Thus hypothetical equivalency values are obtained below scaled distances of about 1.9 m/kg$^{1/3}$ (4.8 ft/lb$^{1/3}$). However, the method does avoid complete neglect of impulse equivalency at small scaled distances due to the discontinuities produced during point-by-point analysis (ref. 3).

An analysis of contributions to the measured peak pressure and impulse showed that the weight of booster material used for these tests is insignificant. To a first approximation, the TNT equivalencies of the C4 booster and the A5 explosive were assured equal, i.e., the actual explosive charge weight is the sum of the booster and test material. Neglect of the booster then corresponds to an error of 1% in weight of explosive and a maximum error of 0.33% in scaled distance. Uncertainties of this magnitude produce corresponding errors in pressure and impulse that are considerably below the standard deviation of reference tables (ref. 1) and are an order of magnitude less than experimental errors in normal blast measurements. The same conclusion is obtained for any reasonable assumption concerning the actual equivalency of the booster material; the contribution may be totally neglected for booster weights on the order of 1%, test material equivalencies in the range of 50 to 300%, and scaled distances in the range of 1 to 16 m/kg$^{1/3}$ (2.52 to 40 ft/lb$^{1/3}$).

Tancreto (ref. 3) has observed that attenuation of peak pressure and impulse due to limited recording system frequency response becomes significant for measurements at small-scaled distances. However, comparison of several records from the Sangamo and Honeywell

instruments revealed no significant differences, and the Sangamo data were primarily used for subsequent computations.

Test Results

Test data sheets for all tests with pertinent measured parameters are given in Appendix A. Selected pretest and post-test still photographs are given in Appendix B. Test numbers shown are for local reference only and provide access to original range data files.

Maximum pressure, scaled positive impulse, and TNT equivalencies are summarized by test configuration in tables 3 through 6 and figures 8 through 15. Fireball duration and diameter as measured from the high-speed motion pictures are given in table 7.

Discussion

The plots of peak pressure versus scaled distance (figs. 8 through 10) from the orthorhombic container tests show the same general trend that has observed in recent TNT equivalency determinations on other explosive and propellant materials (refs. 2-5). Compared to corresponding TNT surface bursts, the observed pressures are higher at far and near field, $Z = 8$ m/kg$^{1/3}$ (20 ft/lb$^{1/3}$) and at near field, $Z = 3$ m/kg$^{1/3}$ (7.5 ft/lb$^{1/3}$) with lower values at intermediate distances. Results of the cylindrical shipping drum tests (fig. 11) show the same general characteristics, although pressures are everywhere greater than those of the referenced material and generally higher than that of the other configurations of A5. Impulse versus distance data show similar tendencies to those obtained for peak pressures.

Essentially S-shaped TNT equivalency curves (figs. 12 thru 15) were obtained by use of maximum data. The composite data (see Summary) show that both pressure and impulse scales with the cube root of charge weight for all tests of the orthorhombic boxes. The difference between impulse equivalency for the cylindrical and orthorhombic cases is not significant, but the pressure equivalency is markedly higher for the large cylindrical tests except at the extremes of scaled distance.

CONCLUSIONS

The TNT equivalency of Composition A5 (Type 1) explosive varies significantly with scaled distance and is generally greater than 100%.

Blast pressure and impulse scales with the cube root of charge weight for orthorhombic configurations of the test material.

The explosive yield from a cylindrical configuration is greater between scaled distances of 1.19 and 15.87 $m/kg^{1/3}$ (3 and 40 $ft/lb^{1/3}$) than that from the orthorhombic configurations.

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Table 1. Composite TNT equivalency by container configuration

Configuration	TNT Equivalency (%) at Scaled Distance											
	1.19 $m/kg^{1/3}$ (3.0 $ft/lb^{1/3}$)		1.61 $m/kg^{1/3}$ (4.05 $ft/lb^{1/3}$)		2.13 $m/kg^{1/3}$ (5.38 $ft/lb^{1/3}$)		3.57 $m/kg^{1/3}$ (9.0 $ft/lb^{1/3}$)		7.14 $m/kg^{1/3}$ (18.0 $ft/lb^{1/3}$)		15.9 $m/kg^{1/3}$ (40 $ft/lb^{1/3}$)	
	P	I	P	I	P	I	P	I	P	I	P	I
Orthorhombic Containers	260	240	290	340	220	160	120	140	130	120	250	160
Cylindrical Shipping Drum	290	270	500	460	330	140	190	140	210	110	210	120

Table 2. Transducer calibration and placement

Channel Number	Scaled Distance $m/kg^{1/3}$ ($ft/lb^{1/3}$)	Calibration Pressure kPa (psig)	Expected Pressure kPa (psig)	R, Distance in Meters (ft) From Charge			
				Charge Weight 11.34 kg (25 lb)	Charge Weight 22.68 kg (50 lb)	Charge Weight 27.22 kg (60 lb)	Charge Weight 68.04 (150 lb)
1,7	1.19 (3.0)	689. (100)	922 (133.7)	2.67 (8.77)	3.37 (11.05)	3.58 (11.7)	4.86 (15.9)
2,8	1.61 (4.05)	414. (60)	468 (67.9)	3.61 (11.84)	4.55 (14.9)	4.83 (15.8)	6.56 (21.5)
3,9	2.13 (5.38)	207.8 (30)	246 (35.6)	4.80 (15.73)	6.04 (19.8)	6.42 (21.1)	8.71 (28.6)
4,10	3.57 (9.0)	68.9 (10)	81.5 (11.8)	8.02 (26.32)	10.11 (33.2)	10.74 (35.2)	14.57 (47.8)
5,11	7.14 (18.0)	34.5 (5)	24.0 (3.49)	16.04 (52.63)	20.21 (66.3)	21.48 (70.5)	29.15 (95.6)
6,12	15.87 (40.0)	34.5 (5)	8.12 (1.18)	35.64 (117.0)	44.92 (147.4)	47.73 (156.6)	64.78 (212.5)

Table 3. Summary of test results 11.34 kg (25 lb) charges

R meters (ft)	Z $m/kg^{1/3}$ $(ft/lb^{1/3})$	P kPa (psi)	I $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	Ep (%)	E_I (%)
2.67 (8.77)	1.19 (3.0)	1720 (250)	380 (42)	250	240
3.61 (11.84)	1.61 (4.05)	970 (240)	320 (35)	290	290
4.80 (15.7)	2.13 (5.38)	410 (60)	180 (20)	210	170
8.02 (26.3)	3.57 (9.0)	76 (11)	100 (11)	110	140
16.04 (52.6)	7.14 (18.0)	31 (4.5)	50 (5.5)	170	120
35.7 (117.0)	15.87 (40.0)	13 (1.9)	24 (2.7)	260	130

Table 4. Summary of test results 22.68 kg (50 lb) charges

P meters (ft)	Z m/kg (ft/lb)	P kPa (psi)	I $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	Ep (%)	E_I (%)
3.37 (11.1)	1.19 (3.0)	1860 (270)	360 (40)	270	230
4.55 (14.9)	1.61 (4.05)	970 (140)	340 (38)	290	310
6.04 (19.8)	2.13 (5.38)	480 (70)	150 (17)	220	130
10.1 (33.2)	3.57 (9.0)	90 (13)	100 (11)	120	140
20.2 (66.3)	7.14 (18.0)	23 (3.4)	70 (7.8)	100	230
44.9 (147.4)	15.87 (40.0)	12 (1.8)	28 (3.1)	250	160

Table 5. Summary of test results 27.22 kg (60 lb) charges

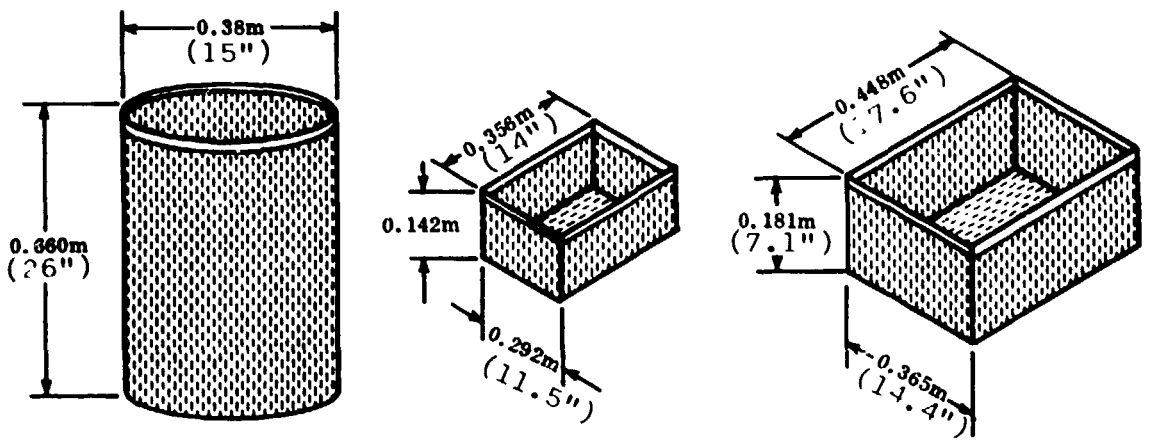
R meters (ft)	Z $m/kg^{1/3}$ $(ft/lb^{1/3})$	P kPa (psi)	I $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	E_p (%)	E_I (%)
3.58 (11.74)	1.19 (3.0)	1720 (250)	400 (44)	250	270
4.83 (15.8)	1.61 (4.05)	970 (140)	410 (45)	290	430
6.42 (21.1)	2.13 (5.38)	550 (80)	180 (20)	290	170
10.7 (35.2)	3.57 (9.0)	90 (13)	100 (11)	120	140
21.5 (70.5)	7.14 (18.0)	28 (4)	43 (4.8)	130	100
47.7 (156.6)	15.87 (40.0)	12 (1.8)	32 (3.5)	250	200

Table 6. Summary of test results 68.04 kg (150 lb) charges

R meters (ft)	Z $m/kg^{1/3}$ $(ft/lb^{1/3})$	P kPa (psi)	I $kPa \cdot ms/kg^{1/3}$ $(psi \cdot ms/lb^{1/3})$	E_p (%)	E_I (%)
4.86 (15.9)	1.19 (3.0)	2000 (290)	400 (44)	290	270
6.56 (21.5)	1.61 (4.05)	1520 (220)	430 (48)	500	460
8.71 (28.6)	2.13 (5.38)	620 (90)	160 (18)	330	140
14.6 (47.82)	3.57 (9.0)	125 (18)	100 (11)	190	140
29.1 (95.6)	7.14 (18.0)	35 (5.1)	46 (5)	210	110
64.8 (212.5)	15.87 (40.0)	1.1 (1.6)	23 (2.5)	210	120

Table 7. Fireball duration and diameter

Charge Weight kg (lb)	Maximum Fireball Diameter meters (ft)	Fireball Duration msec
11.34 (25)	9.14 (30)	98
27.22 (60)	13.7 (45)	162
68.04 (150)	17.4 (57)	248



CYLINDRICAL SHIPPING DRUM (FIBERBOARD)

SIMULATED CONVEYOR OR SCALED SHIPPING BOX (FIBERBOARD)

ORTHORHOMBIC SHIPPING BOX (FIBERBOARD)

Figure 1. Composition A5 containers.

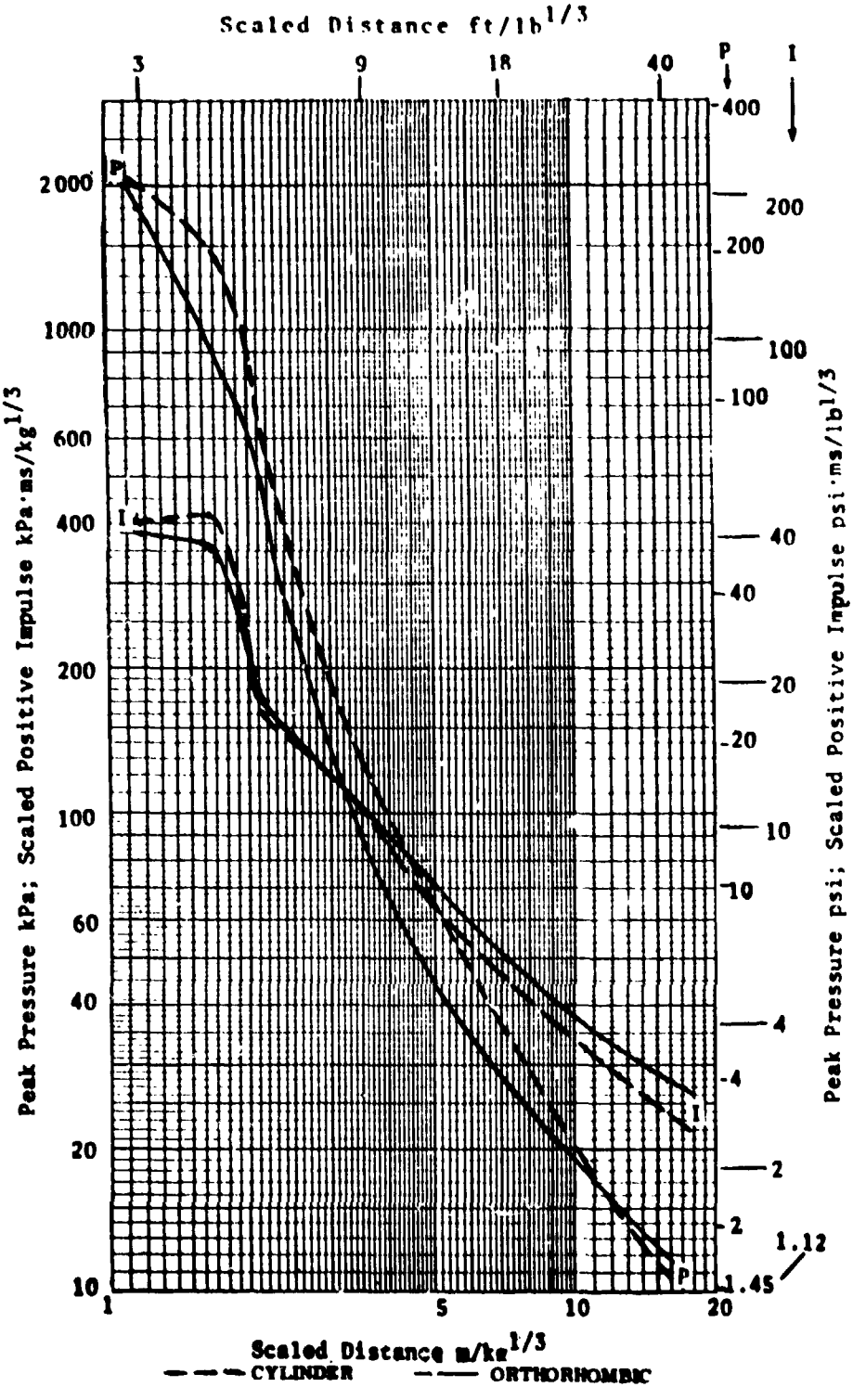


Figure 2. Composite pressure and impulse vs scaled distance.

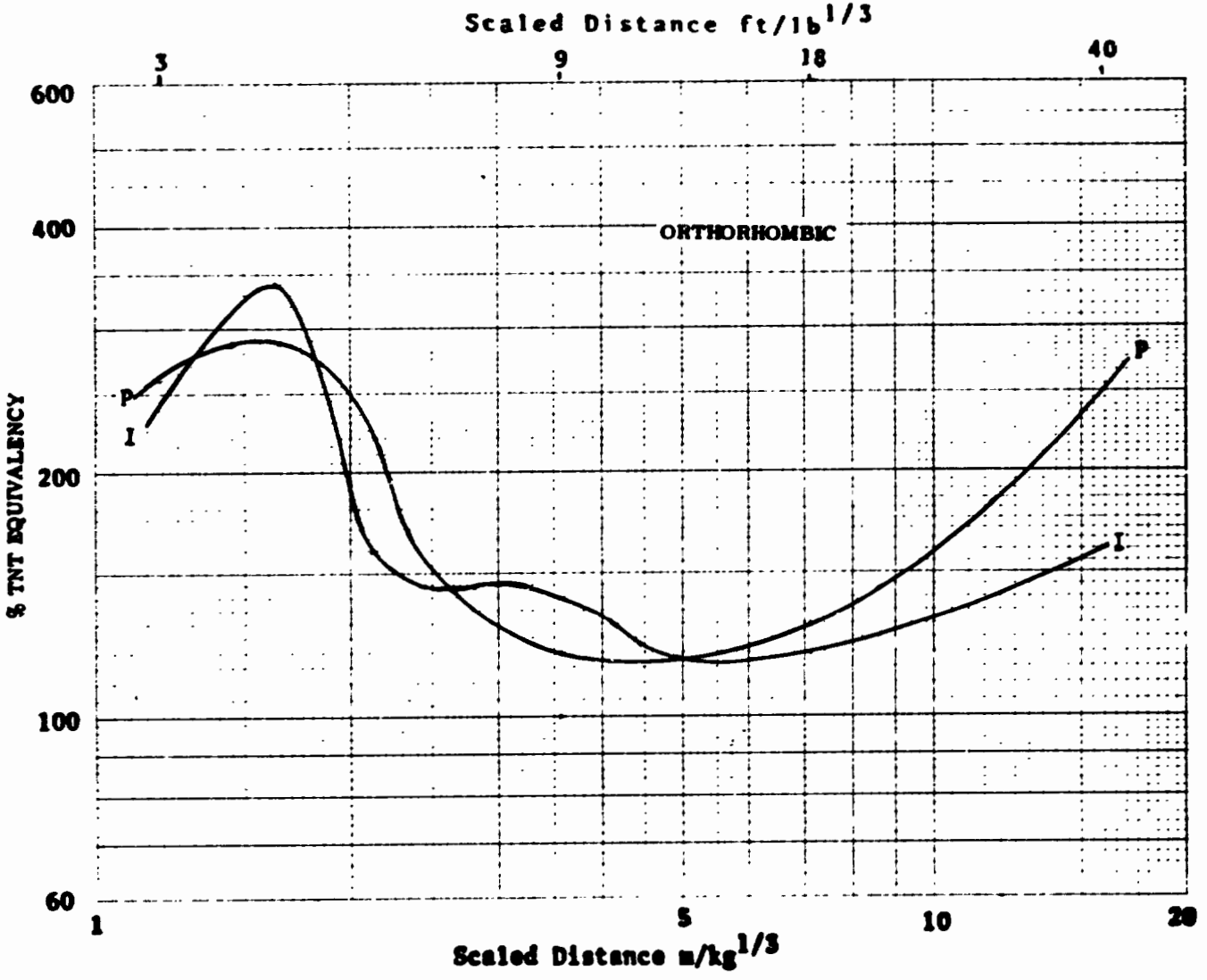


Figure 3. Composite TNT equivalency for orthorhombic configuration.

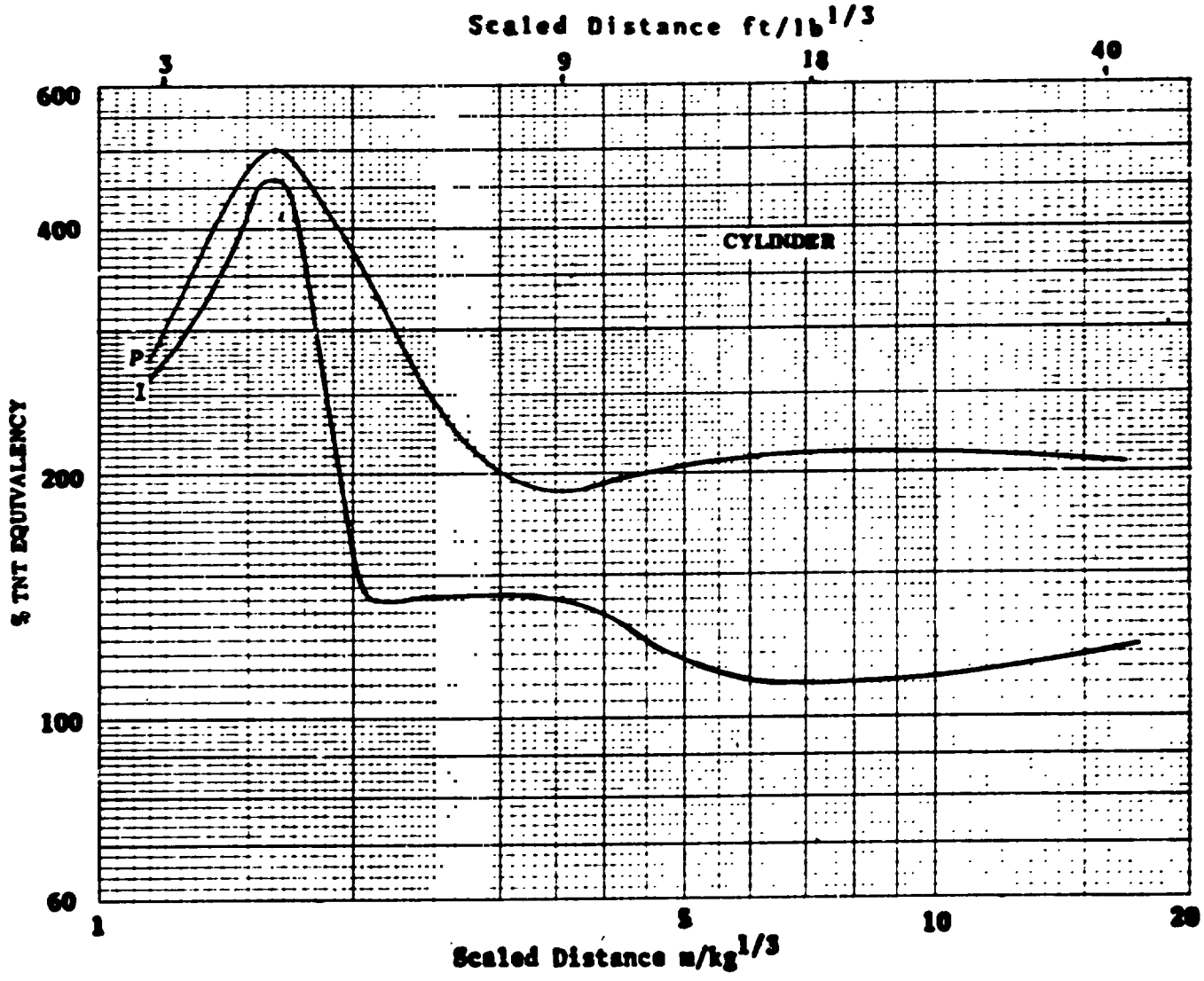
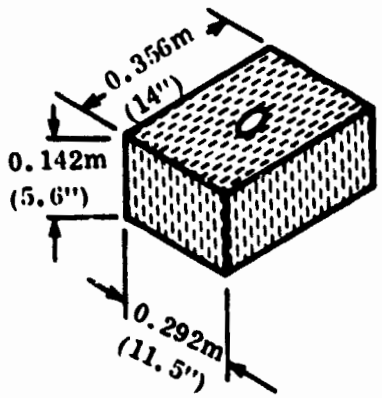
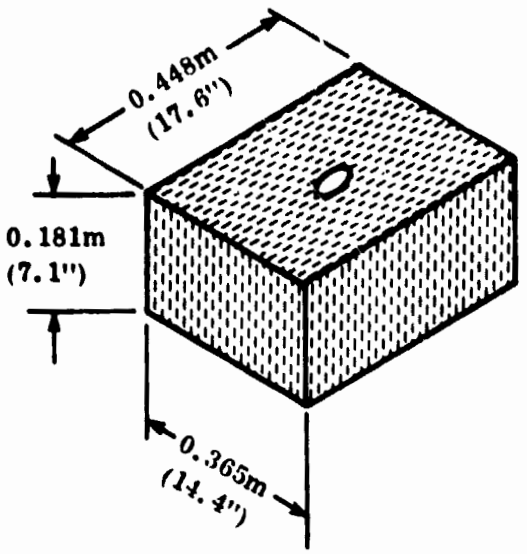


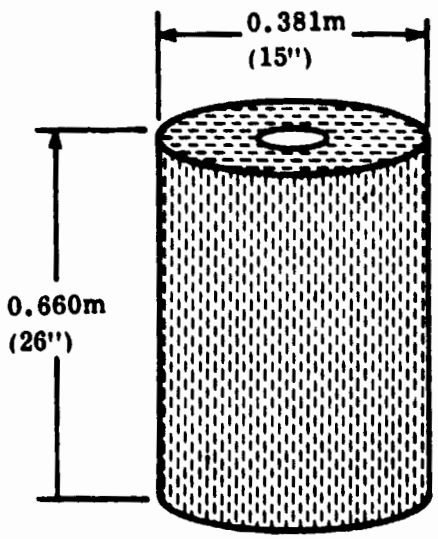
Figure 4. Composite TNT equivalency for cylindrical configuration.



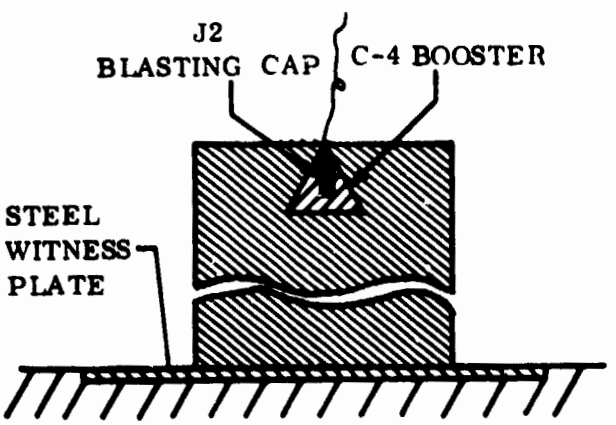
(a) Scaled Shipping B



(b) Full Scale Shipping Box



(c) Full Scale Shipping Drum



(d) Booster and Charge Placement

Figure 5. Test container configurations.

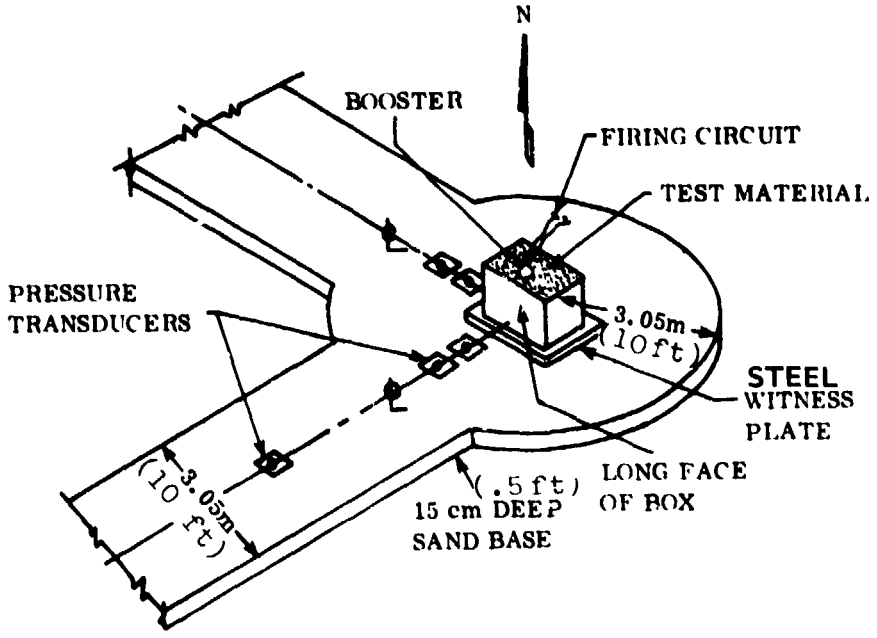


Figure 6. Typical charge placement for equivalency tests.

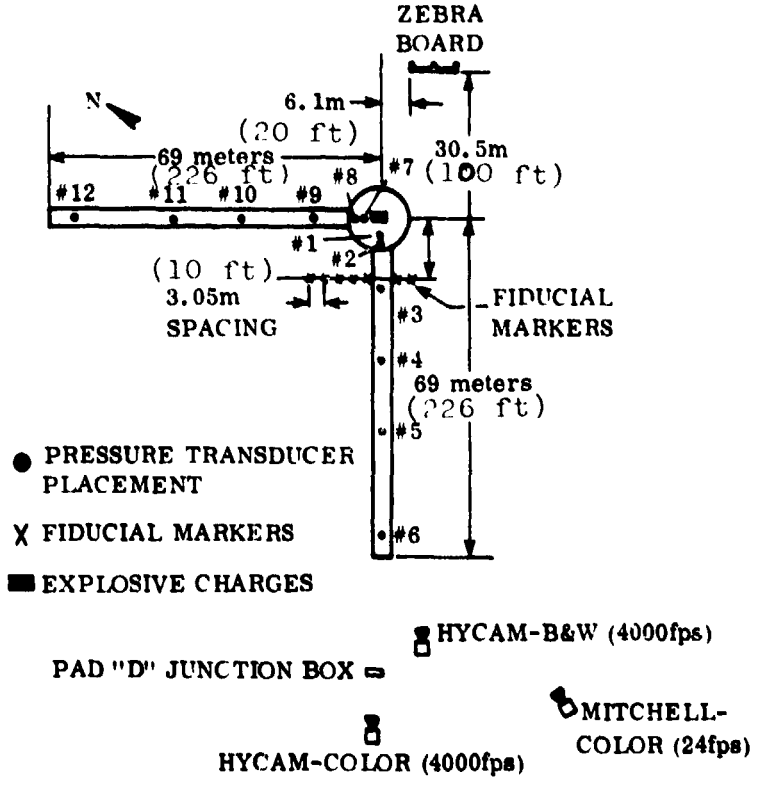


Figure 7. Test area showing transducer and camera placement

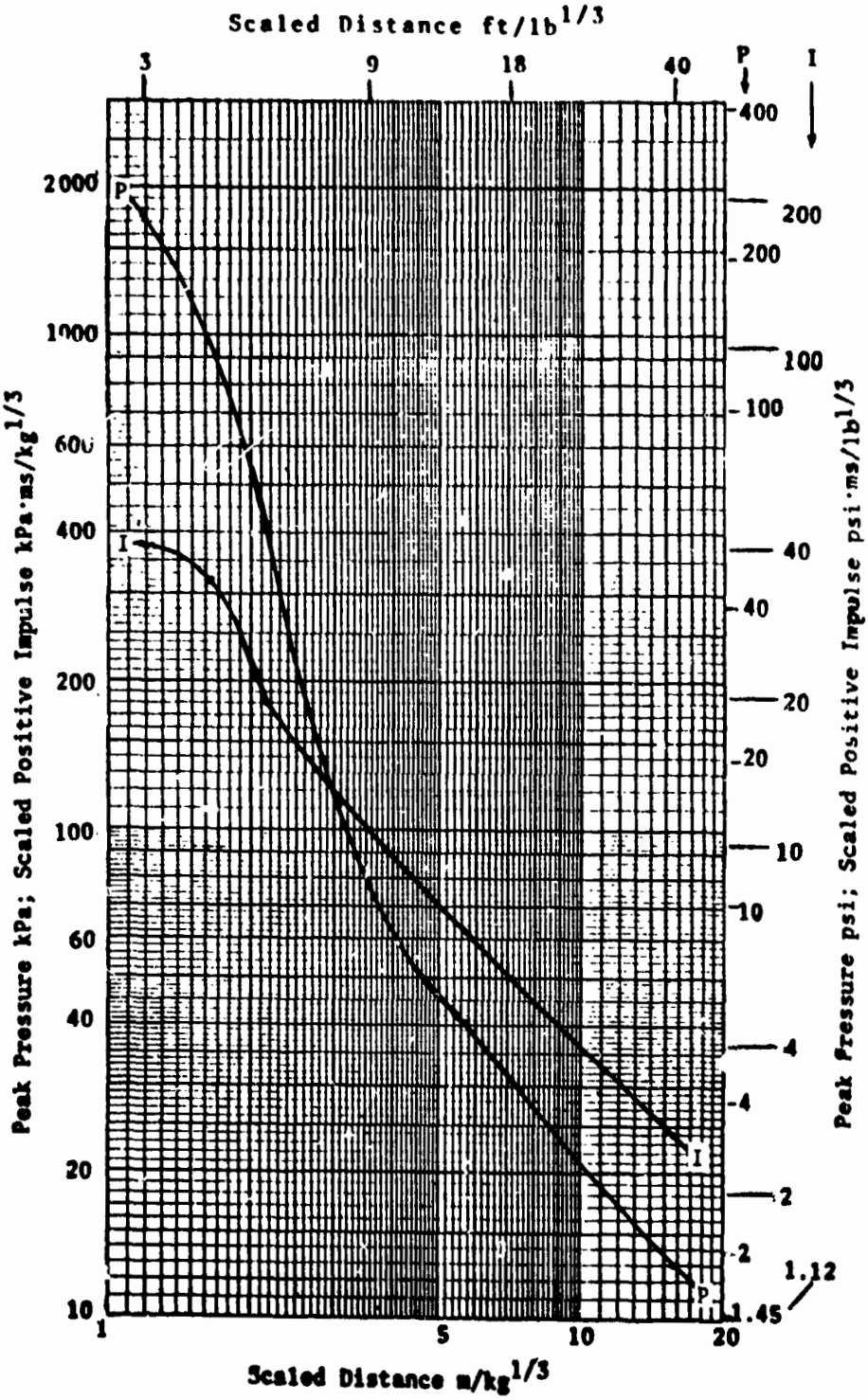


Figure 8. Pressure and impulse vs scaled distance, 11.34 kg (25 lb) charges.

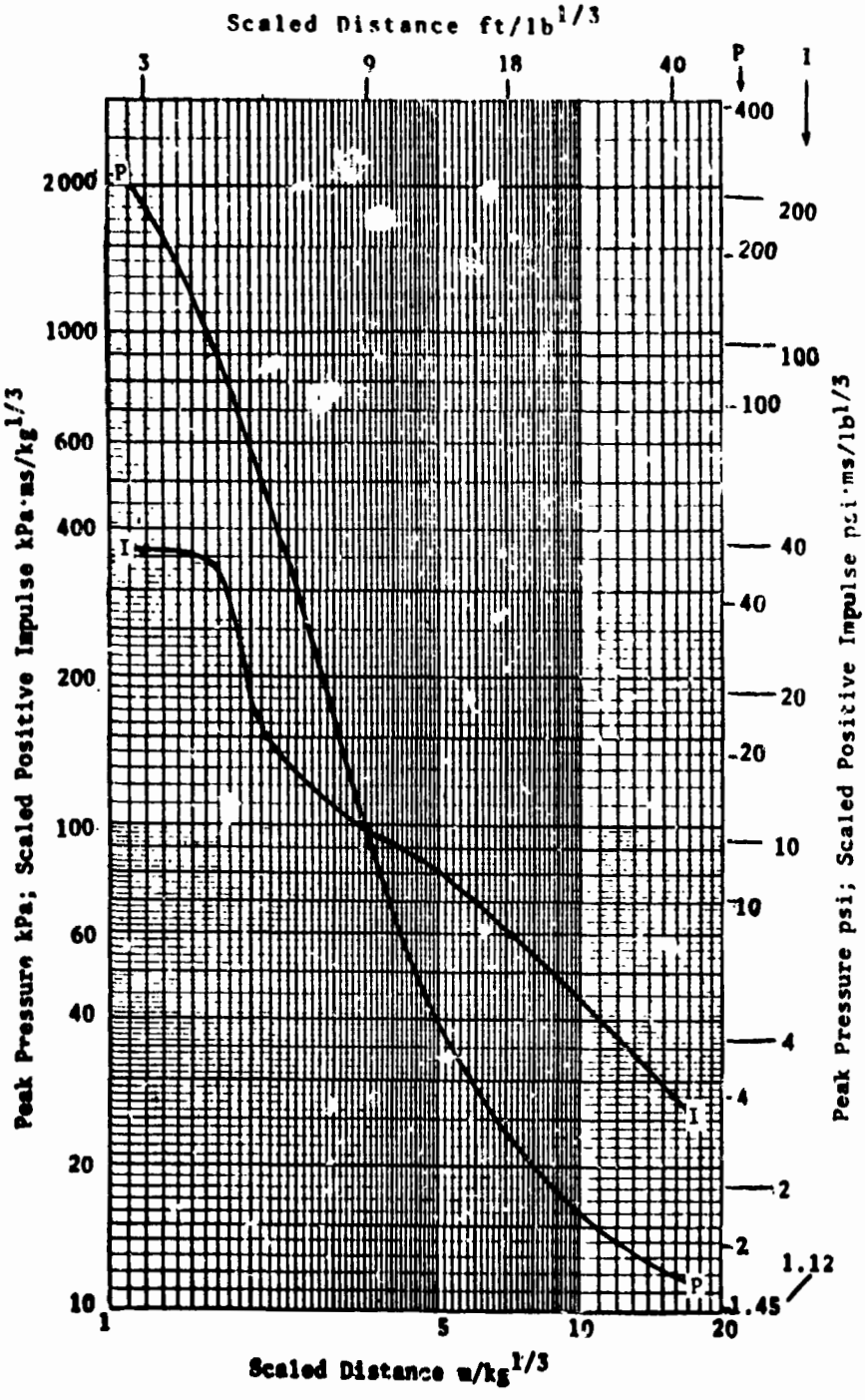


Figure 9. Pressure and impulse vs scaled distance, 22.68 kg (50 lb) charges.

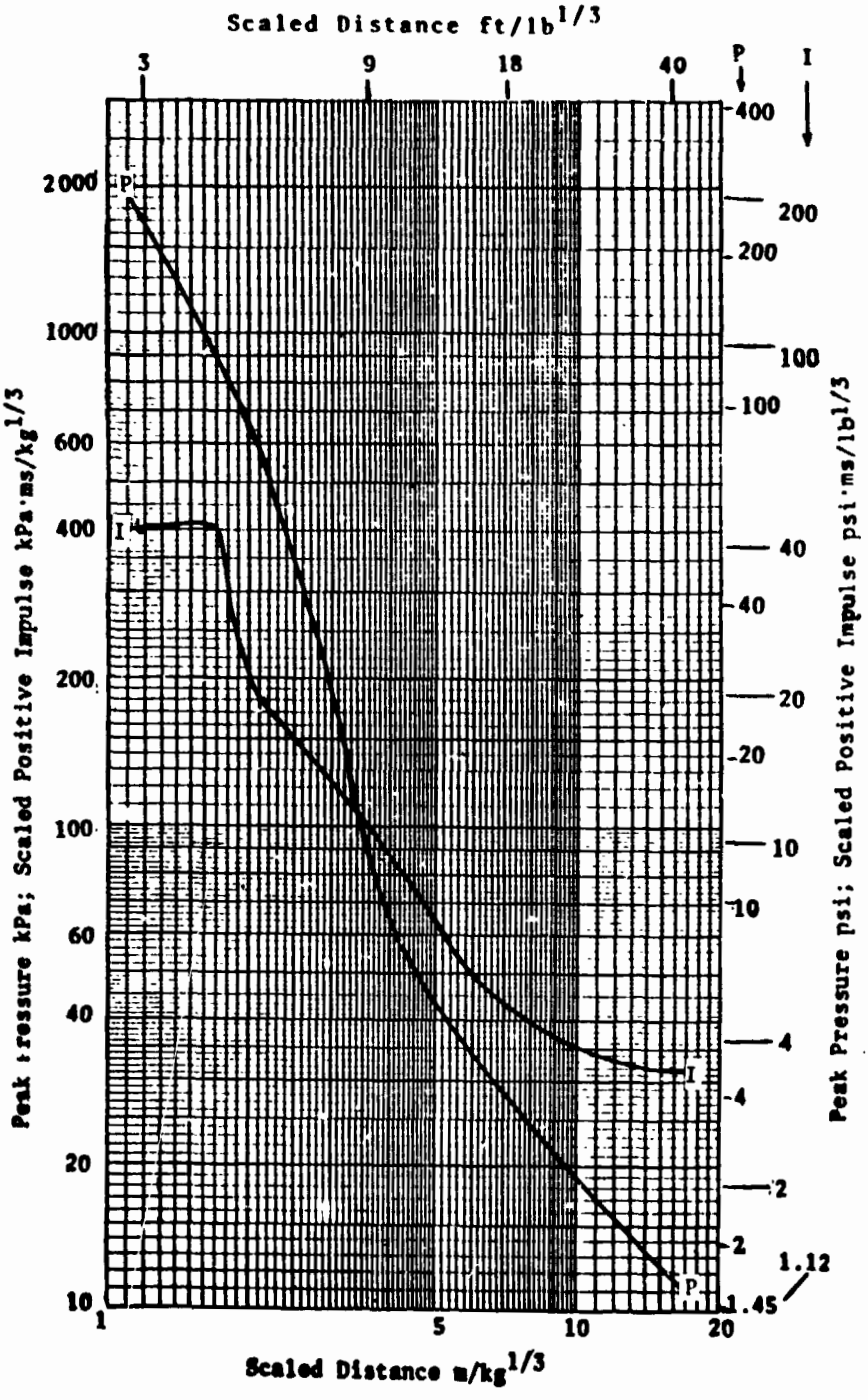


Figure 10. Pressure and impulse vs scaled distance, 27.22 kg (60 lb) charges.

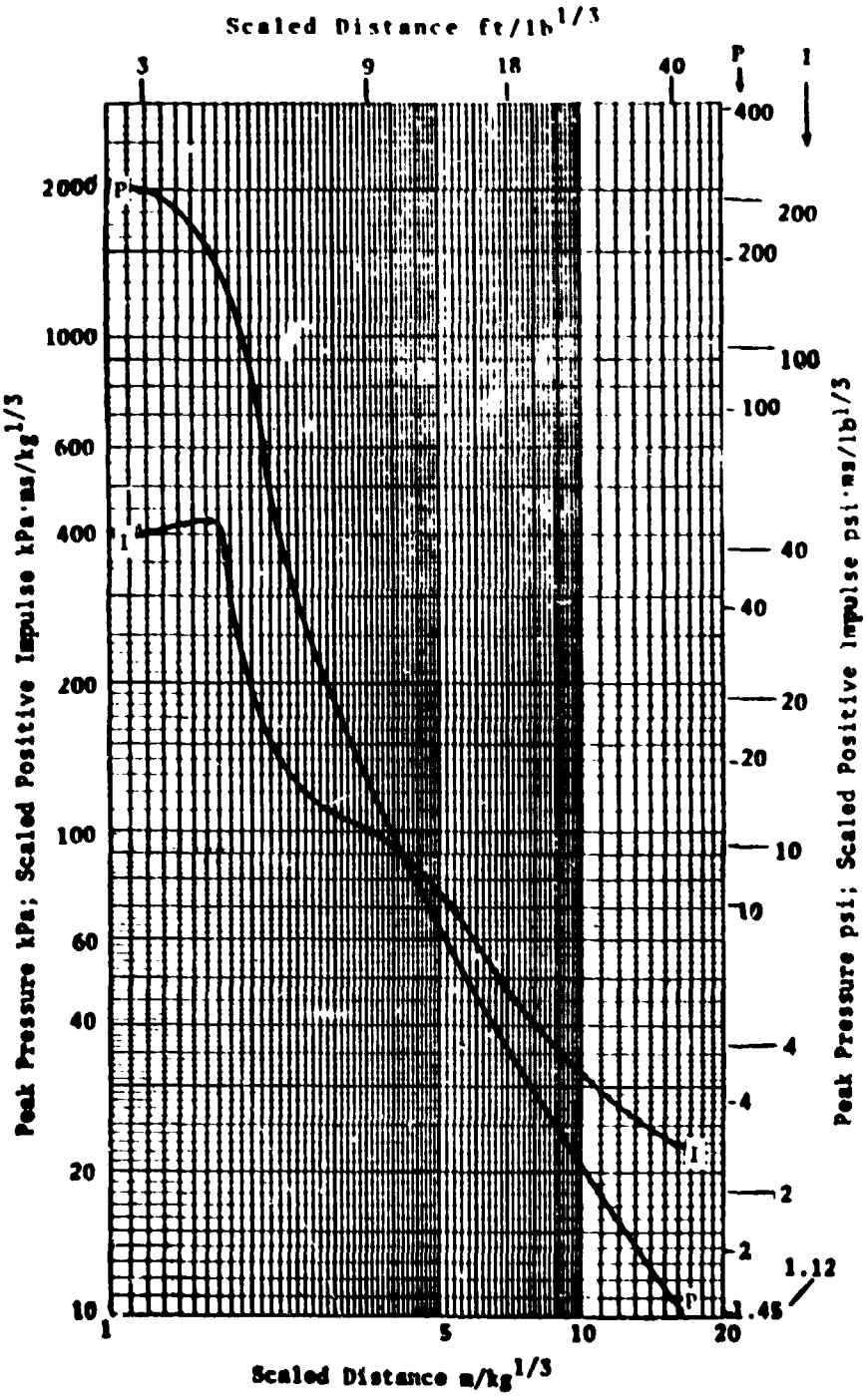


Figure 11. Pressure and impulse vs scaled distance, 68.04 kg (150 lb) charges.

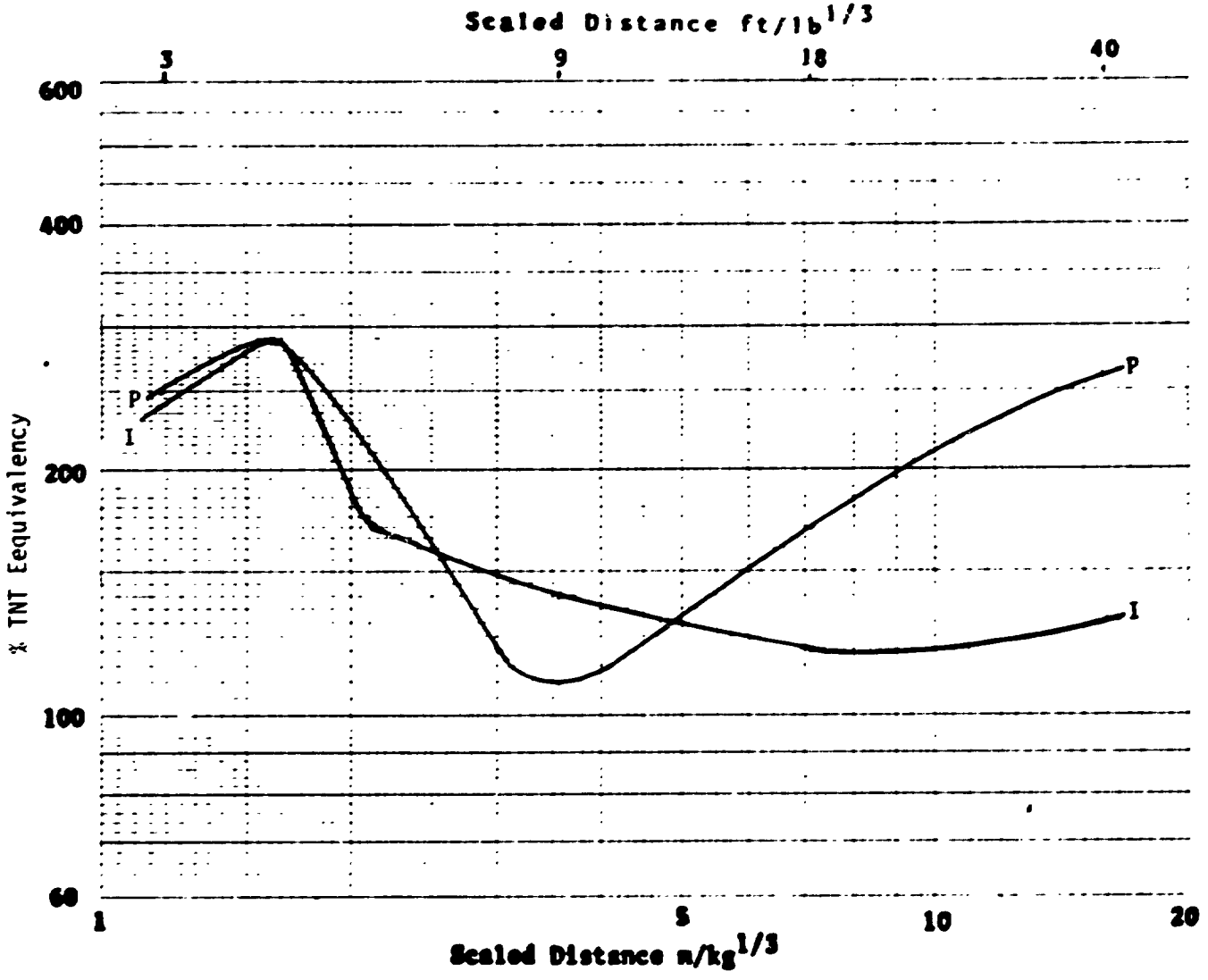


Figure 12. Pressure and impulse TNT equivalencies, 11.34 kg (25 lb) charges.

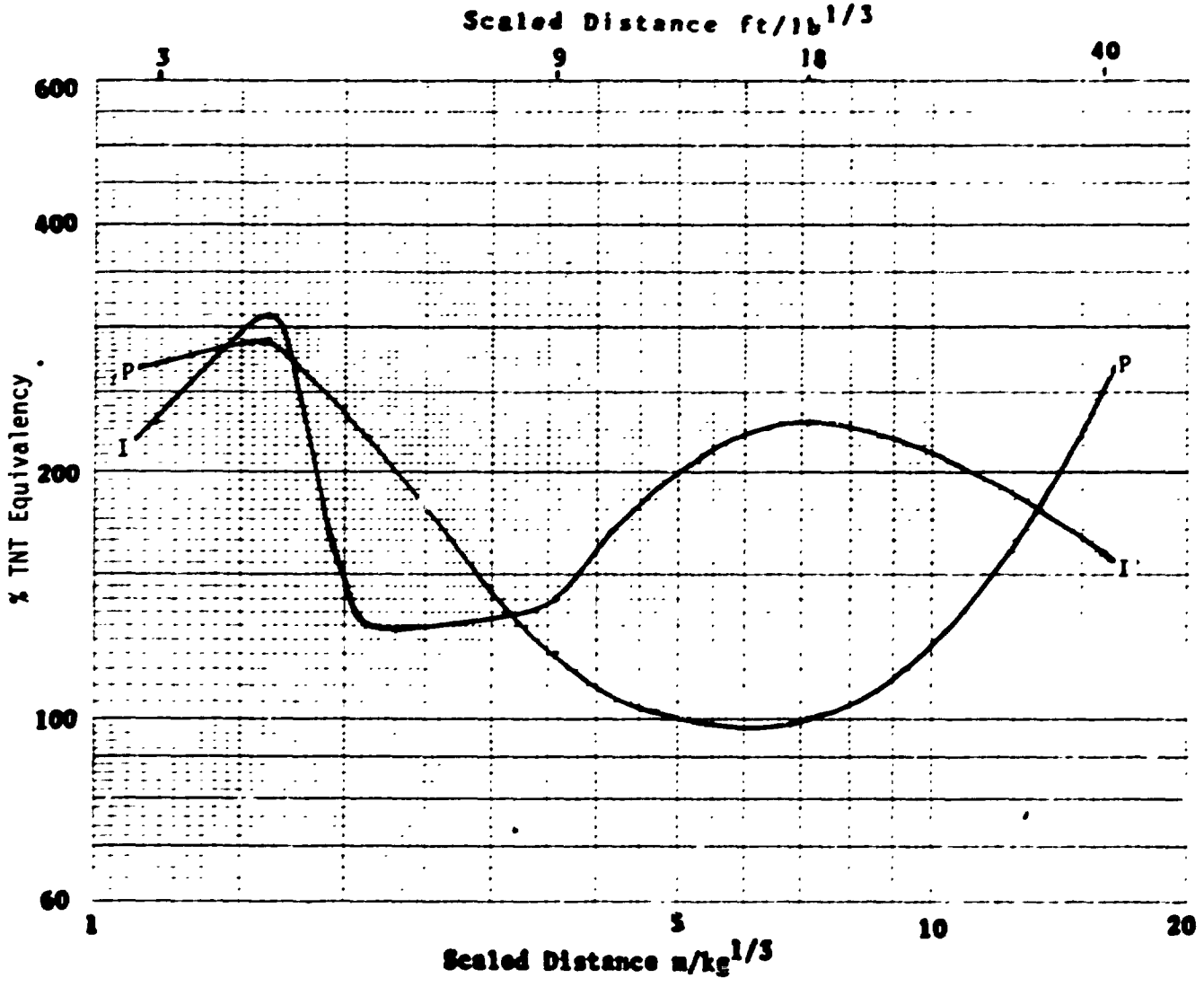


Figure 13. Pressure and impulse TNT equivalencies, 22.68 kg (50 lb) charges.

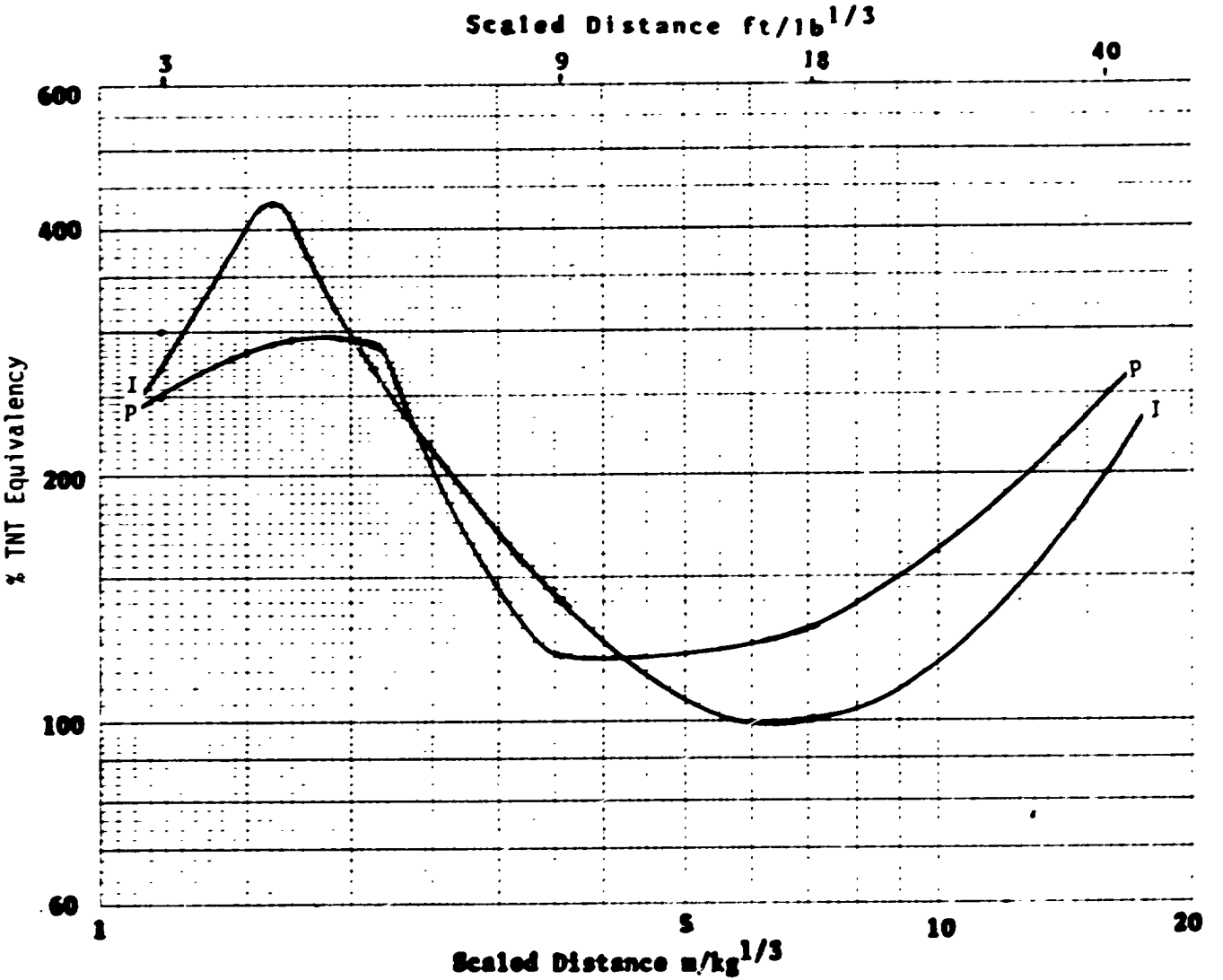


Figure 14. Pressure and impulse TNT equivalencies, 27.22 kg (60 lb) charges.

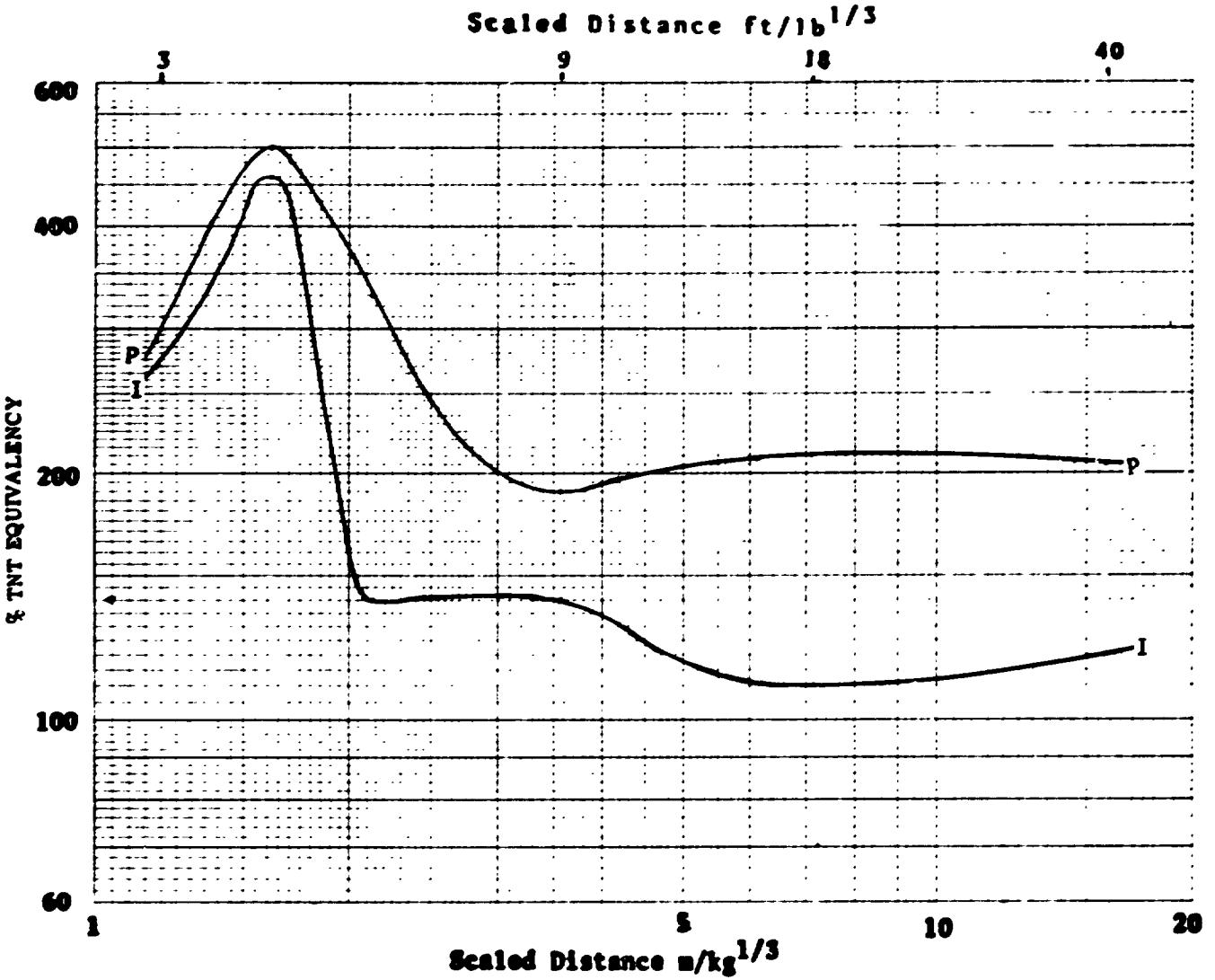


Figure 15. Pressure and impulse TNT equivalencies, 68.04 kg (150 lb) charges.

APPENDIX A

TEST DATA SHEETS, TNT EQUIVALENCY OF COMPOSITION A5

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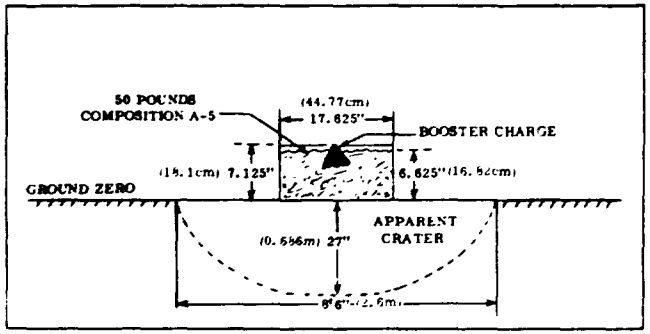
Test Number 05-6-01A$_1$

TEST TITLE	Explosive Equivalency Testing	DATE	1/27/76
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1252
SAMPLE WEIGHT	50 lbs/22.68 kg	TEMP.	51°F/10.56°C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	28%
BOOSTER WT.	0.25 lbs/0.113 Kg C-4 40.5% Charge Wt.	BAR. PRESS.	30.32
TEST NO.	05-6-01A1	WIND DIR.	310°
CONTRACT NO.	NAS8-27750	WIND VEL.	12 Knots



FIELD EVALUATION

Total detonation occurred; all instrumentation channels functioned; crater diameter 8'6", nominal depth 27"

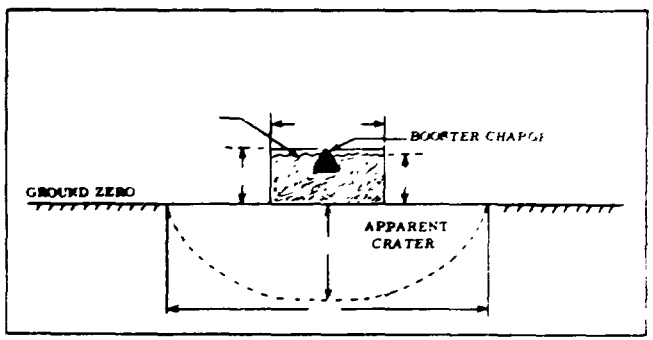
EXPERIMENTAL RESULTS

A1 Test, 22.68 kg (50 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa · msec · kg $^{-1/3}$ (psi · msec · lb $^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.37 (11.06)	1768 (256)	270 (41)	1.10	
7		1848 (268)	239 (36)	1.15	
2	4.55 (14.9)	717 (104)	260 (39)	2.10	Limited
8		858 (124)	270 (41)	2.05	
3	8.04 (19.8)	345 (50)	101 (11.2)	-	Poorly Defined Peak Edge
9		331 (48)	108 (12.0)	3.00	
4	10.11 (33.2)	74 (10.7)	83 (9.2)	11.2	
10		80 (11.6)	84 (9.4)	10.0	
5	20.21 (66.3)	23 (3.3)	37 (4.1)	39.7	
11		21 (3.1)	38 (4.2)	36.6	
6	44.9 (147.4)	12 (1.7)	23 (2.6)	109.2	
12		9 (1.3)	23 (2.6)	109.65	

Test Number 05-6-01A_2

TEST TITLE	Explosive Equivalency Testing	DATE	1/27/76
TEST SAMPLE	Composition A-5 Original Shimming Container	TIME	1350
SAMPLE WEIGHT	50 lbs/22.68 kg	TEMP.	53°F/11.67°C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	26%
BOOSTER WT.	0.5 lbs/0.227 Kg Comp. C-4 1.0% Charge Wt	BAR. PRESS.	30.03
TEST NO.	05-6-01A_2	WIND DIR.	343°
CONTRACT NO	NAS8-27750	WIND VEL.	14 knots



FIELD EVALUATION

Complete detonation occurred; test results indicate that the 1.0% booster charge weight shall be used for the remainder of the tests; crater dimension 0.762 meter deep by 1.2 meters wide.

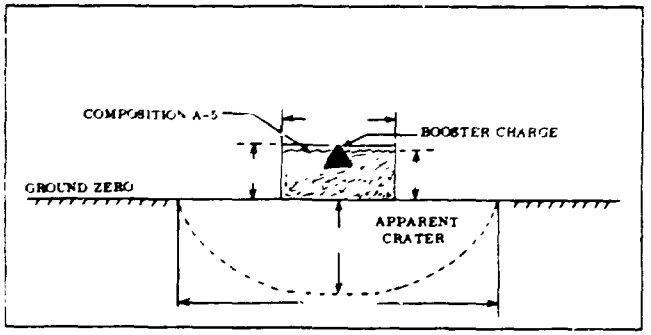
EXPERIMENTAL RESULTS

A2 Test 22.68 kg (50 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.37 (11.05)	1600 (232)	350 (29)	1.20	
7		1827 (265)	340 (35)	1.20	
2	4.55 (14.9)	765 (111)	280 (31)	2.45	
8		889 (129)	260 (29)	2.60	
3	6.04 (19.8)	-	-	-	Bad Transducer
9		434 (63)	111 (12.4)	4.60	
4	10.11 (33.2)	69 (10)	99 (11.0)	12.0	
10		90 (13)	90 (10.0)	11.2	
5	20.21 (66.3)	21 (3.1)	32 (3.6)	40.4	
11		21 (3.0)	39 (4.4)	39.6	
6	44.9 (147.4)	12 (1.8)	27 (3.0)	109.6	
12		10 (1.4)	29 (3.2)	109.5	

Test Number 05-6-01A$_3$

TEST TITLE	Explosive Equivalency Testing	DATE	1/27/76
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1501
SAMPLE WEIGHT	50 lbs/22.68 kg	TEMP.	53°F/1.67°C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	24%
BOOSTER WT	0.5 lbs/0.227 Kg	BAR. PRESS.	30.03
TEST NO.	05-6-01A$_3$ Comp. C-4 1% of Charge Wt.	WIND DIR.	310°
CONTRACT NO.	NAS8-27750	WIND VEL.	15 Knots



FIELD EVALUATION

Total amounts of material was consumed; all instrumentation functioned; crater dimension 0.787 meter deep by 3.53 meters wide.

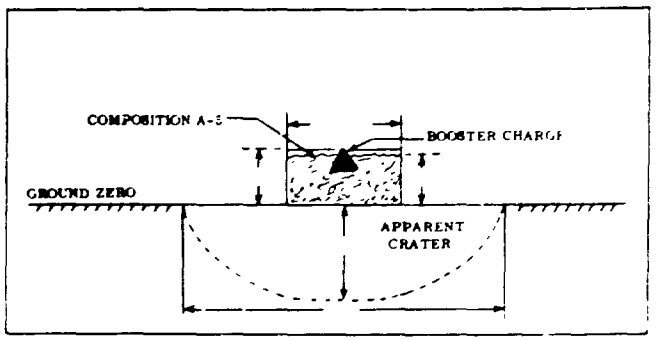
EXPERIMENTAL RESULTS

A3 Test. 22.68 kg (50 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.37 (11.06)	1703 (247)	280 (22)	1.35	
7		1703 (247)	300 (34)	1.10	
2	4.55 (14.9)	793 (115)	230 (26)	2.50	
8		1103 (160)	310 (35)	2.00	
3	6.04 (19.8)	483 (70)	101 (11.2)	4.60	
9		379 (55)	150 (17)	3.90	
4	10.11 (33.2)	83 (12)	92 (10.3)	11.0	
10		70 (10.2)	81 (9.0)	10.35	
5	20.21 (66.3)	24 (3.5)	38 (4.5)	39.55	
11		21 (3.0)	36 (4.0)	36.55	
6	44.9 (147.4)	12 (1.7)	22 (2.4)	109.6	
12		9 (1.3)	26 (2.9)	106.6	

Test Number 05-6-01A$_4$

TEST TITLE	Explosive Equivalency Testing	DATE	1/28/76
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1314
SAMPLE WEIGHT	60 lbs/27.22 kg	TEMP.	55°F/12.78°C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	21%
BOOSTER WT.	0.6 lbs/0.27 Kg Comp. C-4 1% of Charge Wt.	BAR. PRESS.	30.31
TEST NO.	05-6-01A$_4$	WIND DIR.	255°
CONTRACT NO.	NAS8-27780	WIND VEL.	4 Knots



FIELD EVALUATION

Complete detonation of all material occurred, all instrumentation functioned, crater dimensions 0.[illegible] 3 meter deep by 3.561 meters wide.

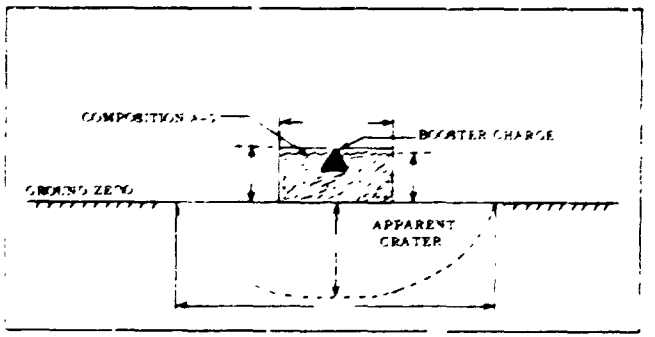
EXPERIMENTAL RESULTS

A4 Test, 27.22 kg (60 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa•msec•kg$^{-1/3}$ (psi•msec•lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.58 (11.74)	1579 (229)	590 (85)	1.00	
7		(264)	730 (81)	1.00	Baseline Drift
2	4.83 (15.8)	1820 (136)	42 (6.1)	1.80	Limited
8		-	-	-	Bad Transducer
3	6.42 (21.1)	352 (51)	150 (17)	3.8	
9		407 (59)	120 (13)	3.8	
4	10.74 (35.2)	63 (9.2)	89 (9.9)	12.9	
10		89 (12.9)	88 (9.9)	12.0	
5	21.48 (70.5)	25 (4.3)	35 (3.9)	41.3	
11		22 (3.2)	42 (4.7)	44.8	
6	47.73 (156.6)	13 (1.85)	23 (2.6)	116.2	Frag Hit?
12		10 (1.40)	21 (2.3)	114.1	

Test Number 05-6-01A5

TEST TITLE	Explosive Equivalency Test	DATE	1/23/74
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1457
SAMPLE WEIGHT	60 lbs/27.22 kg	TEMP.	54°F/12.2°C
POSITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	35%
BOOSTER WT.	0.5 lbs/0.27 Kg Comp. C-4 13 of Charge Wt	BAR. PRESS.	30.26
TEST NO.	05-6-01A5	WIND DIR.	180°
CONTRACT NO.	NASA-27719	WIND VEL.	13 Knots



FIELD EVALUATION

Complete detonation of all materials, all instrumentation functioned, crater dimensions 5.737 meters deep by 2.53 meters wide.

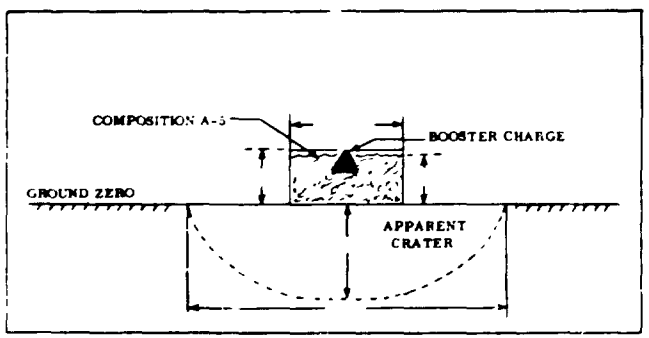
EXPERIMENTAL RESULTS

A5 Test 27.22 kg (60 lb) Composition A5

Channel No.	Distance Meters (ft.)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.58 (11.74)	-	-	1.35	Overranged
7		1765 (256)	600 (46)	1.15	
2	4.83 (15.8)	965 (140)	230 (26)	1.88	
8		(85)	210 (23)	1.75	Frag Hit?
3	6.42 (21.1)	586 (78)	110 (13)	4.28	
9		455 (66)	-	3.20	Broken Cable
4	10.74 (35.2)	79 (11.5)	87 (9.7)	12.56	
10		75 (10.6)	82 (9.1)	11.98	
5	2.68 (79.5)	21 (3.0)	36 (4.0)	41.2	
11		23 (3.4)	44 (5.1)	44.5	
6	47.73 (156.6)	11 (1.62)	24 (2.7)	116.8	
12		11 (1.64)	22 (2.4)	115.4	

Test Number 06-6-03E$_1$

TEST TITLE	Explosive Equivalency Test	DATE	2/4/76
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1341
SAMPLE WEIGHT	60 lbs/27.22 kg	TEMP.	72°F/22.2°C
IGNITION SOURCE	#2 Engineer's Special Blasting Cap	HUMIDITY	66%
BOOSTER WT.	0.5 lbs/0.22 Kg Comp. C-4 1% of Charge Wt.	BAR. PRESS.	30.17
TEST NO.	06-6-03E$_1$	WIND DIR.	125°
CONTRACT NO.	NAS8-27750	WIND VEL.	15 Knots



FIELD EVALUATION
Complete detonation; crater dimension 0.610 meter deep by 3.27 meters wide.

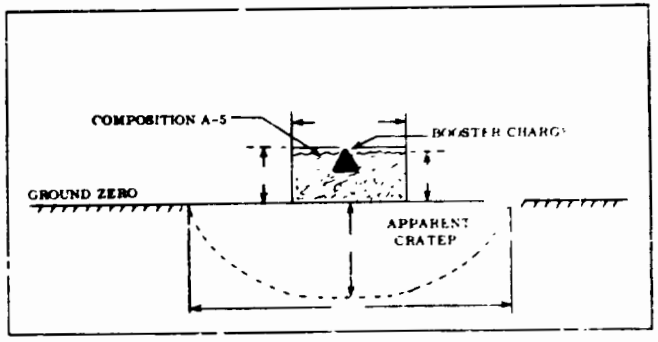
EXPERIMENTAL RESULTS

E1 Test. 27.22 kg (60 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	8.58 (11.74)	1578 (229)	380 (43)	0.86	
7		1675 (243)	320 (36)	1.20	
2	4.83 (15.8)	1303 (189)	340 (38)	2.00	Limited
8		886 (129)	290 (32)	2.25	Triple Peak
3	8.43 (21.1)	517 (75)	180 (20)	3.60	
9		462 (67)	135 (15)	4.20	
4	10.74 (35.2)	89 (12.9)	101 (11.3)	11.7	
10		117 (17)	93 (10.4)	12.35	Frag Hit?
5	21.48 (70.5)	17 (2.5)	36 (4.0)	36.2	
11		30 (4.3)	42 (4.7)	39.5	
6	47.73 (156.6)	10 (1.45)	41 (4.6)	113.2	
12		12 (1.68)	29 (3.2)	111.8	

Test Number 06-6-03E$_2$

TEST TITLE	Explosive Equivalency Test	DATE	2/4/76
TEST SAMPLE	Composition A-5 Original Shipping Container	TIME	1430 Hrs.
SAMPLE WEIGHT	60 lbs/27.22 kg	TEMP.	70 F/21.1 C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	7%
BOOSTER WT.	0.5 lbs/0.23 Kg Comp. C-4	BAR. PRESS.	30.16
TEST NO.	06-6-03E$_2$	WIND DIR.	95°
CONTRACT NO.	NAS8-27750	WIND VEL.	11 knots



FIELD EVALUATION

This test was performed to determine differences in aspect ratio upon possible reinforcement.

Crater dimensions 0.835 meter deep by 3.479 meters wide.

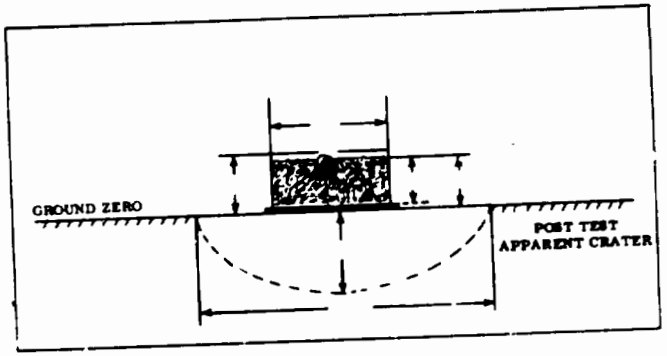
EXPERIMENTAL RESULTS

E2 Test 27.22 kg (60 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	3.58 (11.74)	465 (67)	310 (34)	1.20	Frag Hit?
7		875 (127)	390 (43)	1.20	
2	4.83 (15.8)	303 (44)	400 (45)	2.05	Limited
8		976 (143)	390 (43)	1.90	
3	6.42 (21.1)	531 (77)	-	3.65	Broken Cable
9		614 (89)	190 (21)	3.10	
4	10.74 (35.2)	89 (12.9)	84 (9.4)	11.8	
10		138 (20)	95 (10.6)	10.0	Ringing
5	21.46 (70.5)	23 (3.3)	35 (3.9)	36.7	
11		39 (5.7)	39 (4.4)	35.4	
6	47.73 (156.6)	12 (1.7)	22 (2.5)	113.0	
12		11 (1.53)	18 (2.0)	107.0	

Te t Number 06-6-02D1

TEST TITLE	Explosive Equivalency Testing	DATE	2/4/76
TEST SAMPLE	Composition A-5 Conveyor Bucket Simulation	TIME	1100 Hrs
SAMPLE WEIGHT	25 lbs/11.34 kg	TEMP.	73
IGNITION SOURCE	1-2 Engineer's Special Blasting Cap	HUMIDITY	80%
BOOSTER WT.	0.25 lbs/0.113 kg Comp. C-4 1% of Charge wt.	BAR. PRESS.	30.01
TEST NO.	06-6-02D1	WIND DIR.	145°
CONTRACT NO.	NASS-27750	WIND VEL.	13 knots



FIELD EVALUATION

Complete detonation

Crater dimension 0.457 meter deep by 2.286 meter wide

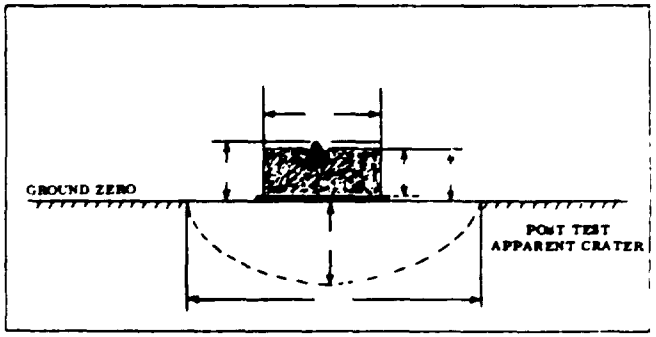
EXPERIMENTAL RESULTS

D1 Test 11.34 kg (25 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	2.67 (8.77)	1800 (261)	520 (58)	0.80	Baseline Drift
7		1520 (220)	310 (34.2)	0.82	
2	3.61 (11.8)	800 (116)	440 (49)	1.40	Baseline Drift
8		1030 (149)	310 (35)	1.50	
3	4.80 (15.7)	330 (48)	160 (18)	2.75	
9		410 (59)	126 (14.0)	2.85	
4	8.02 (26.3)	69 (10)	97 (10.8)	8.80	
10		76 (11)	108 (12.0)	8.60	
5	16.04 (52.6)	29 (4.2)	36 (4.0)	19.6	
11		21 (3.0)	49 (5.4)	20.2	
6	35.6 (117.0)	12 (1.7)	23 (2.6)	84.7	
12		11 (1.6)	24 (2.7)	83.1	

Test Number 05-6-02B_2

TEST TITLE	Explosive Equivalency Testing	DATE	1 29/76
TEST SAMPLE	Composition A-5 Conveyor Bucket Simulation	TIME	1421 Hrs
SAMPLE WEIGHT	25 lbs/11.34 kg	TEMP.	67°, 19.4°C
IGNITION SOURCE	1-8 Engineer's Special Blasting Cap	HUMIDITY	21
BOOSTER WT.	0.25 lbs/0.113 kg Comp. C-4 Lead Charge wt.	BAR. PRESS.	30.12
TEST NO.	05-6-02B_2	WIND DIR.	270
CONTRACT NO.	NASB-27750	WIND VEL.	12 knots



FIELD EVALUATION

All data channels functioned. Good test Total amount was consumed 1/ booster charge weight was utilized for the remainder of the tests

Crated dimensions 0.457 meter deep by 1.93 meter wide.

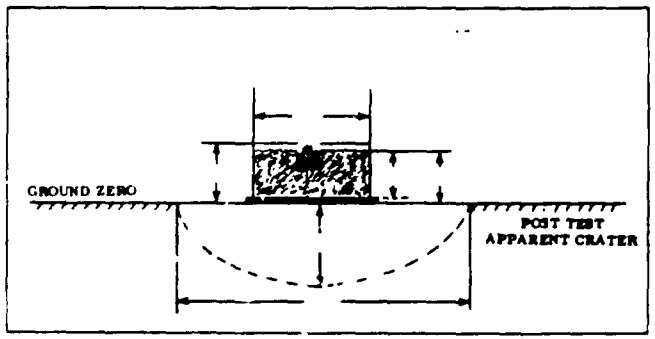
EXPERIMENTAL RESULTS

B_2 Test 11.34 kg (25 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa·msec·kg$^{-1/3}$ (psi·msec·lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	2.67 (8.77)	1530 (222)	200 (29)	0.80	
7		1830 (265)	300 (43)	0.80	
2	3.61 (11.8)	860 (125)	410 (60)	1.50	Frag Hit?
8		870 (126)	310 (35)	1.58	
3	4.80 (15.7)	460 (67)	120 (13)	2.9	
9		460 (67)	180 (18)	2.95	
4	8.02 (26.3)	66 (9.6)	104 (11.6)	9.25	
10		78 (11)	83 (9.2)	9.25	
5	16.04 (52.6)	23 (3.3)	35 (3.9)	37.3	
11		20 (2.9)	52 (5.8)	37.2	
6	35.6 (117.0)	12 (1.8)	31 (2.5)	88.5	
12		7.6 (1.1)	22 (2.4)	86.6	

Test Number 05-6-02B$_3$

TEST TITLE	Explosive Equivalency Testing	DATE	1/29/76
TEST SAMPLE	Composition A-6 Conveyor Bucket Simulation	TIME	1515 Hrs
SAMPLE WEIGHT	25 lbs/11.34 kg	TEMP.	68°F/20°C
IGNITION SOURCE	1-2 Engineer's Special Blasting Cap	HUMIDITY	20%
BOOSTER WT.	0.75 lbs/11.34 kg Comp. C-4 1% of Charge wt.	BAR. PRESS.	30.10
TEST NO.	05-6-02B$_3$	WIND DIR.	280°
CONTRACT NO.	NAS8-27750	WIND VEL.	12 knots



FIELD EVALUATION

Good test all systems function. Complete detonation

Crater dimension 0.467 meter deep by 3.210 meter wide

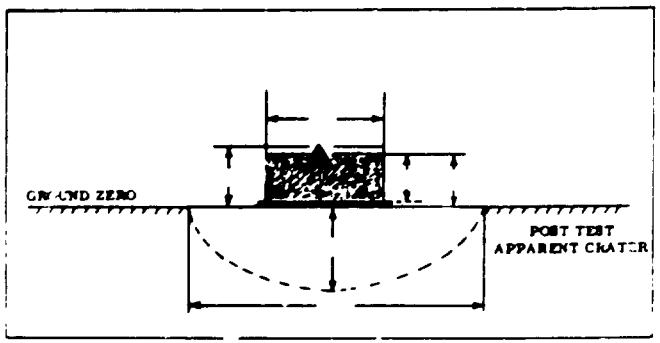
EXPERIMENTAL RESULTS

B3 Test: 11.34 kg (25 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa·msec·kg$^{-1/3}$ (psi·msec·lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	2.67 (8.77)	1400 (215)	200 (33)	0.75	
7		1400 (214)	200 (40)	0.80	
2	3.61 (11.8)	1000 (145)	200 (31.5)	1.20	
8		800 (139)	200 (32)	1.40	
3	4.80 (15.7)	370 (53)	135 (15)	2.80	
9		420 (61)	120 (14)	3.00	
4	8.02 (26.3)	64 (9.3)	90 (10.5)	8.4	
10		72 (10.5)	64 (7.1)	8.18	1st Peak
5	16.04 (52.6)	25.5 (3.7)	34 (3.8)	30.5	
11		20 (2.9)	41 (4.6)	29.6	
6	35.6 (117.0)	12 (1.8)	22 (2.4)	88.6	
12		7.6 (1.1)	24 (2.7)	85.4	

Test Number 05-6-02B4

TEST TITLE	Explosive Equivalency Testing	DATE	1 30/75
TEST SAMPLE	Composition A-6 Conveyor Bucket Simulation	TIME	1307 Hrs
SAMPLE WEIGHT	25 lbs/11.34 kg	TEMP.	70°F/21 1°C
IGNITION SOURCE	1-8 Kartpeer's Special Blasting Cap	HUMIDITY	23%
BOOSTER WT.	0.25 lbs/.113 kg	BAR. PRESS.	30.10
TEST NO.	05-6-02B4	WIND DIR.	230°
CONTRACT NO.	NASA-87150	WIND VEL.	12 knots



FIELD EVALUATION

Complete detonation, all systems functioned

Crater dimension @ .508 meter deep x 2.438 meter wide

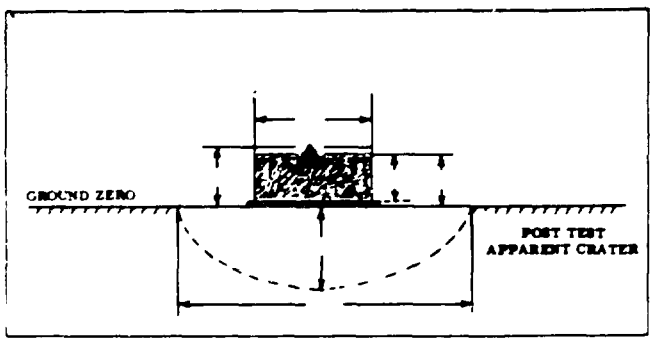
EXPERIMENTAL RESULTS

B4 Test 11.34 kg (25 lb) Composition A6

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg -1/3 (psi • msec • lb -1/3)	Time of Arrival (msec)	Remarks
1	2.67 (8.7')	1100 (160)	390 (43)	0.60	Limited
7		1650 (240)	320 (36)	0.60	
2	3.61 (11.8)	970 (140)	270 (30)	1.00	
8		850 (123)	-	1.15	Cut Cable
3	4.80 (15.7)	330 (48)	190 (21)	2.15	
9		370 (54)	160 (18)	2.4	
4	9.02 (26.3)	67 (9.7)	80 (8.9)	8.0	
10		62 (9.0)	79 (8.8)	8.55	
5	16.04 (52.6)	15 (2.2)	36 (4.0)	24.4	
11		34 (5.0)	49 (5 5)	30.2	
6	35 6 (117.0)	8.3 (1.2)	17 (1.9)	64 0	
12		14 (2.0)	23 2.6	64.0	

Test Number 05-6-02B$_5$

TEST TITLE	Explosives Equivalency Testing	DATE	1/24/76
TEST SAMPLE	Composition A-5 25 lb Shipping Container	TIME	1401 Hrs
SAMPLE WEIGHT	25 lbs	TEMP.	70°F/21.1°C
IGNITION SOURCE	J-8 Engineer's Special Blasting Cap	HUMIDITY	24%
BOOSTER WT.	1/4 lb or 1% of Charge wt.	BAR. PRESS.	29.29
TEST NO.	05-06-02B$_5$	WIND DIR.	200°
CONTRACT NO.	NAS8-27750	WIND VEL.	13 knots



FIELD EVALUATION

Complete detonation

Crater dimension 0.457 meter deep by 2.184 meter wide

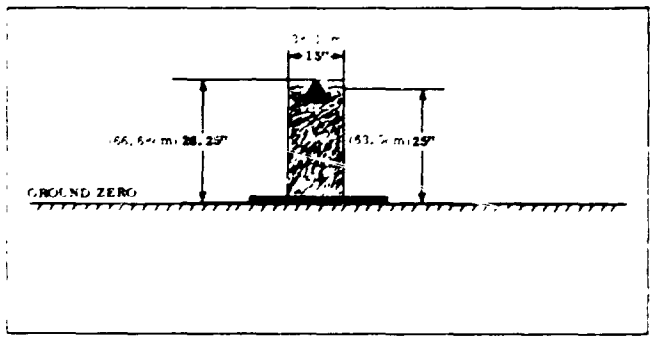
EXPERIMENTAL RESULTS

B5 Test 11.34 kg (25 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa·msec·kg$^{-1/3}$ (psi·msec·lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	2.67 (8.77)	1270 (184)	380 (42)	0.65	Limited
7		1540 (224)	320 (36)	0.60	
2	3.61 (11.8)	965 (140)	290 (32)	1.35	
8		920 (134)	300 (33)	1.35	
3	4.80 (15.7)	330 (48)	121 (13.5)	2.75	
9		380 (55)	171 (19.0)	2.80	
4	9.02 (24.3)	69 (10)	82 (10.2)	8.9	
10		76 (11)	70 (7.8)	9.3	
5	16.04 (52.6)	16 (2.3)	35 (3.9)	30.0	
11		34 (5.0)	57 (6.4)	30.5	
6	35.6 (117.0)	8.3 (1.2)	19 (2.1)	65.0	
12		13 (1.9)	28 (3.8)	66.06	

Test Number 05-6-03C$_1$

TEST TITLE	Explosive Equivalency Testing	DATE	1/31/76
TEST SAMPLE	Composition A-5 Fiber Shipping Drum	TIME	1231
SAMPLE WEIGHT	150 lbs 68.04 kg	TEMP.	57°F/13.9°C
IGNITION SOURCE	#8 Engineer's Special Blasting Cap	HUMIDITY	80%
BOOSTER WT	75 lbs 34 kg Composition C-4 @ 57% of Charge wt	BAR. PRESS.	29.80
TEST NO	05-6-03C$_1$	WIND DIR.	140°
CONTRACT NO	NAS4-27750	WIND VEL.	10 knots



FIELD EVALUATION

Failed to achieve 100% detonation

Focal point data accumulated

Motion picture coverage 40mm B/W failed to run

2000 fps color movie and 24 fps documentary functioned

No crater data obtained

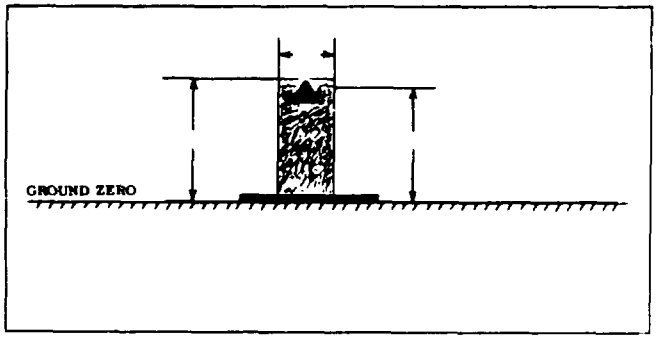
EXPERIMENTAL RESULTS

C1 Test 68.04 kg (150 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	4.88 (15.9)	1960 (287)	310 (35)	1.85	
7		1860 (272)	310 (36)	1.70	
2	6.56 (21.5)	1270 (184)	360 (40)	2.88	
8		1300 (189)	300 (33)	2.90	
3	8.71 (28.6)	580 (84)	132 (14.7)	4.80	
9		570 (83)	147 (16.4)	4.88	
4	14.58 (47.8)	94 (13.6)	78 (8.8)	14.8	
10		125 (17.8)	59 (6.6)	15.7	
5	29.15 (95.6)	19.3 (2.8)	30 (2.3)	51.6	
11		34 (5.0)	42 (4.7)	51.1	
6	64.78 (212.5)	8.6 (1.25)	19 (2.1)	150.6	
12		10.0 (1.45)	21 (2.3)	148.3	

Test Number 05-6-03C_2

TEST TITLE	Explosive Equivalency Test	DATE	1/31/76
TEST SAMPLE	Composition A-5 Fiber Shipping Drum	TIME	1402 Hrs
SAMPLE WEIGHT	150 lbs/68.04 kg	TEMP.	65°F/18.3°C
IGNITION SOURCE	J-2 Engineer's Special Blasting Cap	HUMIDITY	67
BOOSTER WT.	1.5 lbs/0.68 kg Comp. C-4 1% of Charge wt	BAR. PRESS.	29.81
TEST NO.	05-06-03C_2	WIND DIR.	140°
CONTRACT NO.	NAS8-27750	WIND VEL.	11 knots



FIELD EVALUATION

Acoustic data amassed for this test series

Complete detonation

Crater dimensions 0.483 meter (1.58 feet) deep by 3.505 meters (11.5 feet) wide

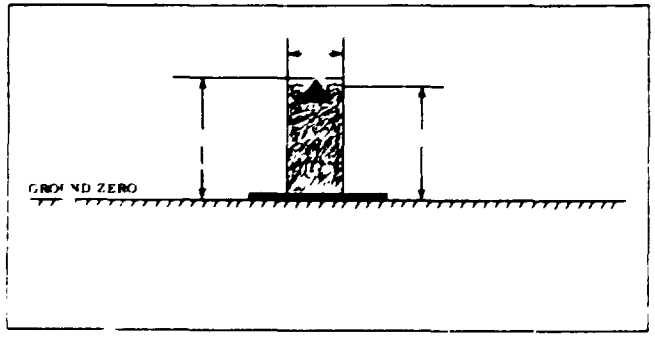
EXPERIMENTAL RESULTS

C2 Test. 68.04 kg (150 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa•msec•kg$^{-1/3}$ (psi•msec•lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	4.86 (15.9)	2020 (293)	580 (65)	1.80	Baseline Drift
7		1840 (267)	310 (35)	1.75	
2	6.58 (21.6)	1050 (152)	175 (19.5)	2.92	Bad Drift
8		1450 (210)	370 (40.9)	2.90	
3	8.71 (28.6)	579 (84)	136 (15.2)	5.40	
9		558 (81)	143 (16.0)	5.22	
4	14.58 (47.8)	128 (18.6)	79 (8.8)	16.1	
10		103 (15.0)	93 (10.4)	15.6	
5	29.15 (95.6)	25 (3.6)	31 (3.5)	52.3	
11		33 (4.8)	46 (5.1)	51.3	
6	64.78 (212.5)	10 (1.39)	20 (2.2)	150.4	
12		11 (1.56)	21 (2.3)	148.7	

Test Number 05-6-03C$_3$

TEST TITLE	Explosive Equivalency Test	DATE	1/31/76
TEST SAMPLE	Composition A-5 Fiber Shipping Drum	TIME	1512
SAMPLE WEIGHT	150 lbs, 68.04 kg	TEMP.	82°F/16.67°C
IGNITION SOURCE	1-8 Engineer's Special Blasting Cap	HUMIDITY	72%
BOOSTER WT	1.5 lbs, 0.68 kg Comp. C-4 at Charge wt	BAR. PRESS.	29.79
TEST NO	05-6-03C$_3$	WIND DIR.	145°
CONTRACT NO.	NAS8-27750	WIND VEL.	11 knots



FIELD EVALUATION

Acoustic focal point data recumulated

Complete Detonation

Crater dimension 0.610 meters (2 feet) deep by 3.658 meters (12 feet) wide

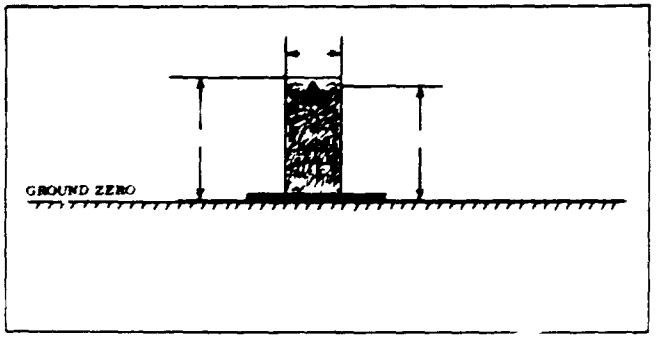
EXPERIMENTAL RESULTS

C3 Test 68.04 kg (150 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa•msec•kg$^{-1/3}$ (psi•msec•lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	4.86 (15.9)	2158 (313)	290 (22)	1.65	
7		1875 (272)	410 (46)	1.60	
2	6.56 (21.5)	1165 (169)	380 (42)	2.80	
6		1655 (240)	370 (41)	2.85	
3	8.71 (28.6)	586 (85)	140 (16)	5.15	
9		583 (96)	126 (14)	5.05	
4	14.58 (47.8)	77 (11.1)	90 (10.0)	14.3	
10		99 (14.4)	86 (9.6)	15.05	
5	29.15 (95.6)	24 (3.5)	32 (3.6)	51.4	
11		33 (4.8)	45 (5.0)	50.9	
6	64.78 (212.5)	10 (1.44)	20 (2.2)	150.6	
12		12 (1.7)	22 (2.4)	148.2	

Test Number 06-6-01C_4

TEST TITLE	Explosive Equivalency Test	DATE	2/3/76
TEST SAMPLE	Composition A-6 Fiber Shipping Drum	TIME	1414 Hrs
SAMPLE WEIGHT	150 lbs/68.04 kg	TEMP.	72°F/22.2°C
IGNITION SOURCE	J-6 Engineer's Special Blasting Cap	HUMIDITY	44%
BOOSTER WT.	1.5 lbs/0.68 kg Comp. C-4 1% of Charge wt	BAR. PRESS.	30.03
TEST NO.	06-6-01C_4	WIND DIR.	180°
CONTRACT NO.	NAS8-27750	WIND VEL.	11 knots



FIELD EVALUATION

Focal point data accumulated

Complete detonation

Crater dimension (0.863 meter) deep by 2.795 meters wide

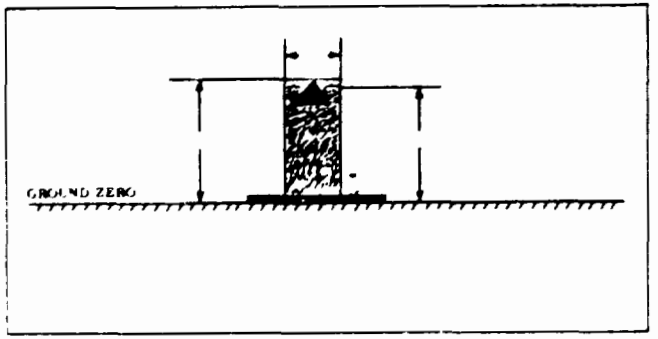
EXPERIMENTAL RESULTS

C4 Test 68.04 kg (150 lb) Composition A6

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa·msec·kg$^{-1/3}$ (psi·msec·lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	4.88 (15.9)	1779 (258)	360 (42.8)	1.70	
7		1578 (229)	480 (44.4)	1.80	
2	6.56 (21.5)	1298 (188)	250 (27.5)	3.05	
8		1517 (220)	430 (46.5)	3.15	
3	8.71 (28.6)	558 (81)	125 (13.9)	5.40	
9		441 (64)	132 (14.7)	5.50	
4	14.58 (47.8)	117 (17)	82 (9.3)	15.35	
10		114 (16.5)	79 (8.8)	16.06	
5	29.15 (95.6)	23 (3.3)	31 (3.5)	51.25	
11		36 (5.2)	45 (5.0)	51.55	
6	64.78 (212.5)	9 (1.35)	22 (2.4)	149.9	
12		11 (1.60)	18 (2.0)	149.1	

Test Number 06-6-01C$_5$

TEST TITLE	Explosive Equivalency Test	DATE	2/3/76
TEST SAMPLE	Composition A-5 Fiber Shipping Drum	TIME	1514 Hrs
SAMPLE WEIGHT	150 lbs/68.04 kg	TEMP.	73°F/22.78°C
IGNITION SOURCE	#8 Engineer's Special Blasting Cap	HUMIDITY	46%
BOOSTER WT	1.25 lbs/.74 kg Comp C-4 13 of Charge wt	BAR. PRESS.	30.02
TEST NO.	06-6-01C$_5$	WIND DIR.	150°
CONTRACT NO.	NAS8-27712	WIND VEL.	7 knots



FIELD EVALUATION

Focal point data accumulated

Complete detonation

Crater dimension 0.711 meter deep by 3.353 meter wide

EXPERIMENTAL RESULTS

C5 Test. 68.04 kg (150 lb) Composition A5

Channel No.	Distance Meters (ft)	Peak Pressure kPa (psi)	Scaled Impulse kPa • msec • kg$^{-1/3}$ (psi • msec • lb$^{-1/3}$)	Time of Arrival (msec)	Remarks
1	4.86 (15.9)	3662 (219)	500 (56)	1.70	Limited and Baseline Drift
7		1676 (229)	396 (44)	1.60	
2	6.56 (21.5)	1813 (263)	560 (62)	2.60	Limited and Baseline Drift
8		896 (130)	486 (81)	2.20	
3	8.71 (28.6)	37 (54)	180 (20)	5.15	Double Peaks
9		482 (70)	220 (24.3)	3.8	Broken Cable
4	14.58 (47.8)	102 (14.8)	86 (9.5)	15.8	
10		68 (10.0)	113 (12.6)	12.6	Limited
5	29.15 (96.6)	13 (2.3)	35 (3.9)	81.6	
11		37 (5.3)	46 (5.1)	81.5	
6	64.78 (214.5)	8 (1.2)	18 (2.0)	150.0	Multiple Peaks
12		8 (1.1)	25 (2.8)	148.6	Multiple Peaks

APPENDIX B

SELECTED PHOTOGRAPHS

Pretest Configuration, 27.22 kg Charge, Showing Transducer Array

Post Test Crater, 27.22 kg Charge

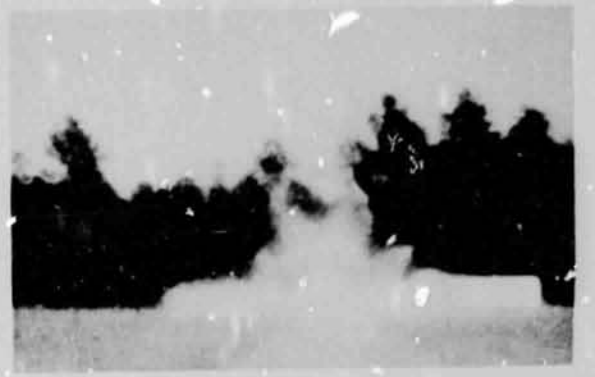
Pretest Congifuration, 11.34 kg Charge

Pretest Configuration, 27.22 kg Charge, Showing Firing Line and Breakwire Cables

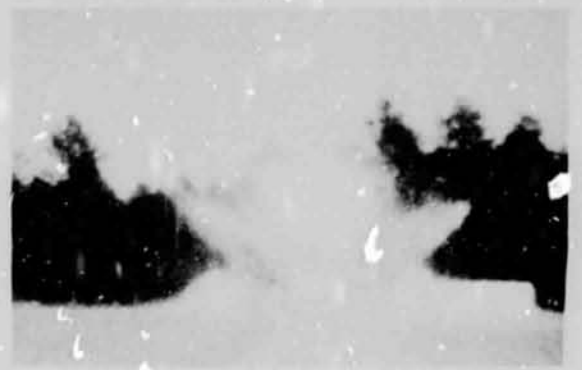
Pretest Configuration, 68.04 kg Charge, Showing Booster Charge and Blasting Cap

Postest Crater, 68.04 kg Charge

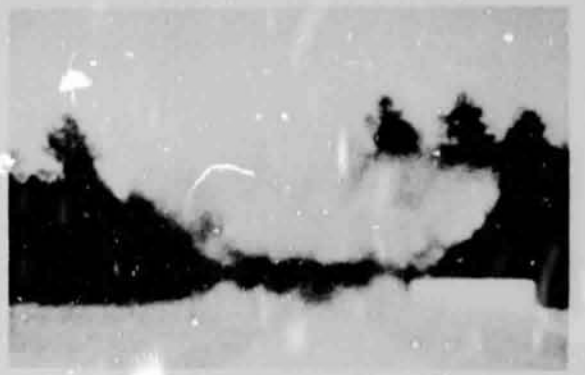
Immediatelv Following Detonation



20 msec Following Detonation



73 msec Following Detonation
(Maximum Diameter)



Dust Cloud at 233 msec Following
Detonation

Fireball Characteristics From 1500fps 16 mm Film
(27.22 kg Composition A5)

SYMBOLS AND ABBREVIATIONS

A5	Composition A5 explosive
E_I	TNT impulse equivalency
E_P	TNT pressure equivalency
ft	feet
$ft/lb^{1/3}$	feet per cube root of pounds
I	impulse (scaled positive impulse)
kg	kilograms
kPa	kilopascal
$kPa \cdot ms/kg^{1/3}$	kiopascal - milliseconds per cube root of kilograms
m	meters
$m/kg^{1/3}$	meters per cube root of kilograms
P	pressure
psi	pounds per square inch
$psi.ms/lb^{1/3}$	pounds per square inch-milliseconds per cube root of pounds
R	radical distance (center-to-center) of charge and pressure gages
W	weight
Z	scaled distance

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